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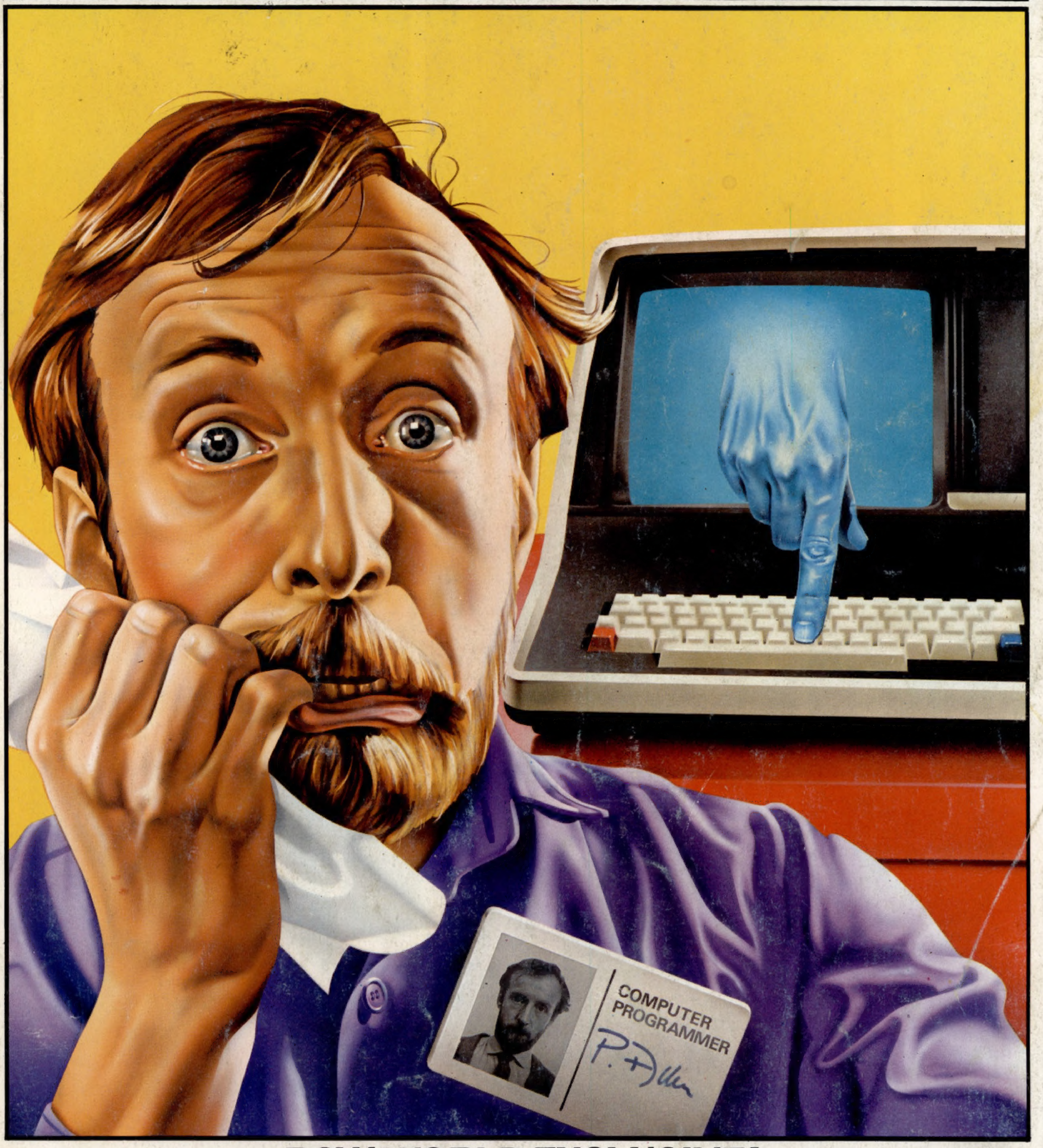
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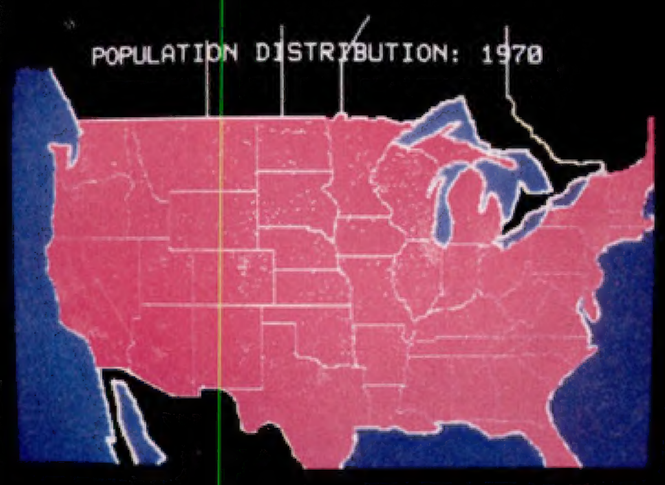
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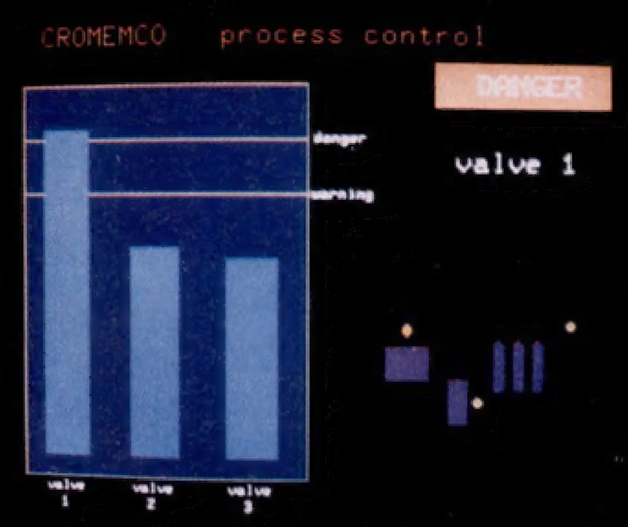
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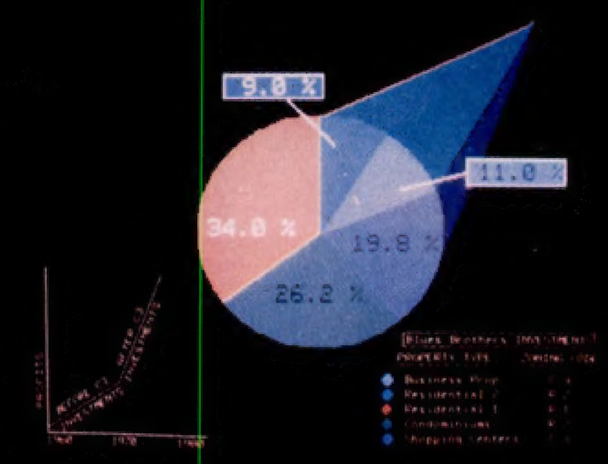
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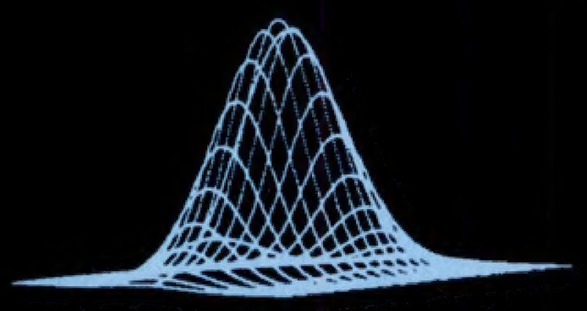
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Art Director
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Shelley Gray

Editorial Office
14 Rathbone Place
London W1P 1DE
01-637 7991

Advertisement Director
Stephen England
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Assistant Advertisement Manager
Patrick Dolan
01-636 4463

Advertisement Executive
Jacquie Hancock
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Jane Hamnell

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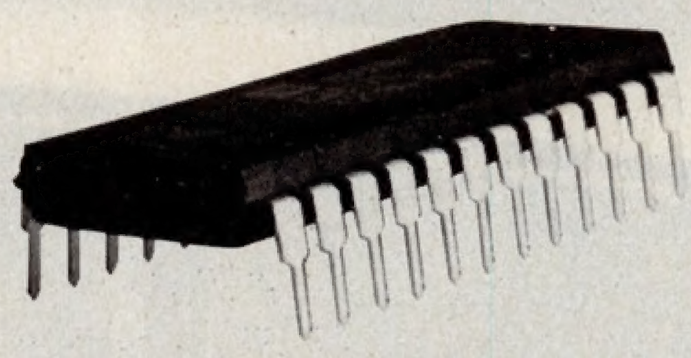
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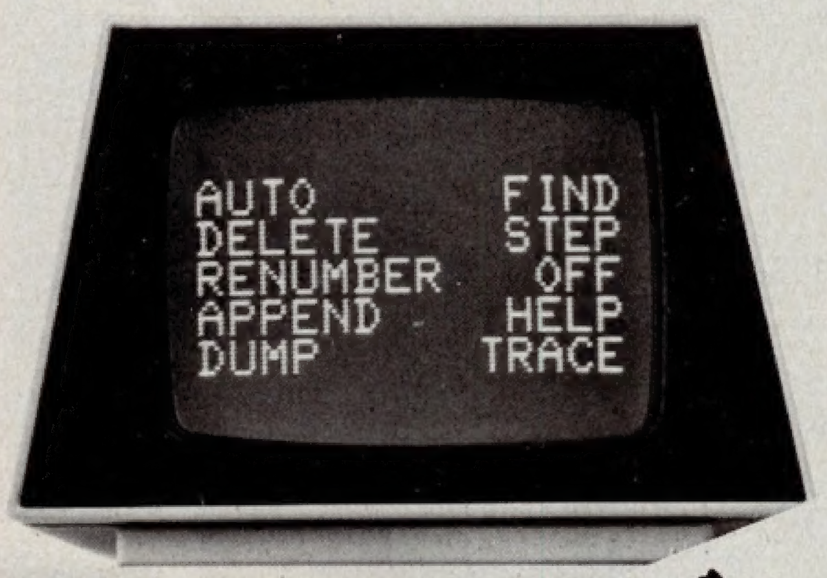
Speed up your PET programming with The BASIC Programmer's Toolkit,™ now only £30.00.

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The BASIC Programmer's Toolkit has two kilobytes of ROM firmware on a single chip. This extra ROM store lets you avoid loading tapes or giving up valuable RAM storage. It plugs into a socket inside your PET system, or is mounted on a circuit board attached on the side of your PET, depending on which model you own.

There are basically two versions of PET. To determine which Toolkit you need, just turn on your PET. If you see ***COMMODORE BASIC*** your PET uses the TK-80P Toolkit. If you see ###COMMODORE BASIC###, your PET uses the TK-160 Toolkit. Other versions of the BASIC Programmer's Toolkit are available for PET systems that have been upgraded with additional memory.





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RENUMBER renumbers the entire program currently in your PET. You can instantly change all line numbers and all references to those numbers. For instance, to start the line numbers with 500 instead of 100, just use *RENUMBER 500.*

HELP is used when your program stops due to an error. Type *HELP,* and the line on which the error occurs will be shown. The erroneous portion of the line will be indicated in reverse video on the screen.

These simple commands, and the other seven listed on the screen, take the drudgery out of program development work. And for a very low cost. The BASIC Programmer's Toolkit costs as little as £30.00 or at most, £45.00.

Get the BASIC Programmer's Toolkit and find out how quick and easy program development can be. See your local PET dealer today.



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Art Director
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Editorial Office
14 Rathbone Place
London W1P 1DE
01-637 7991

Advertisement Director
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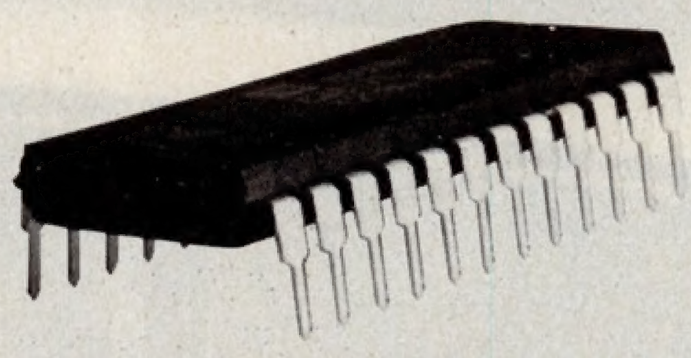
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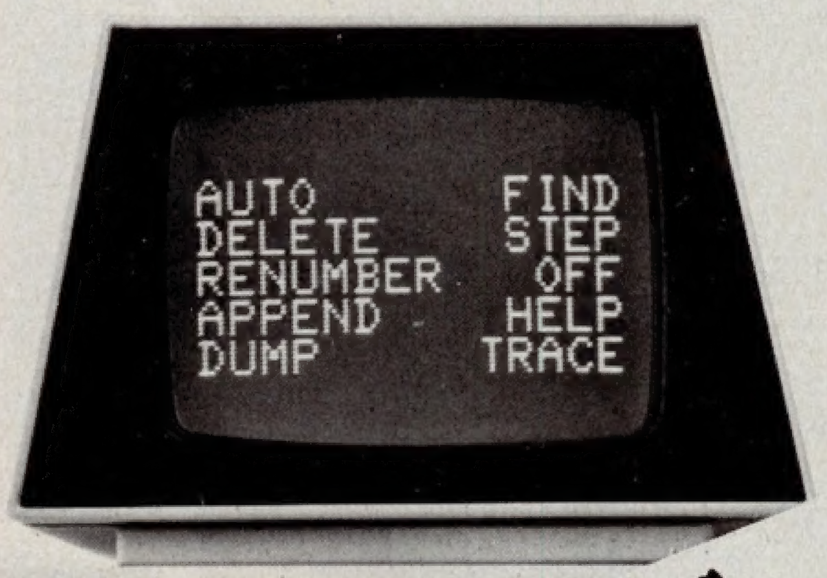
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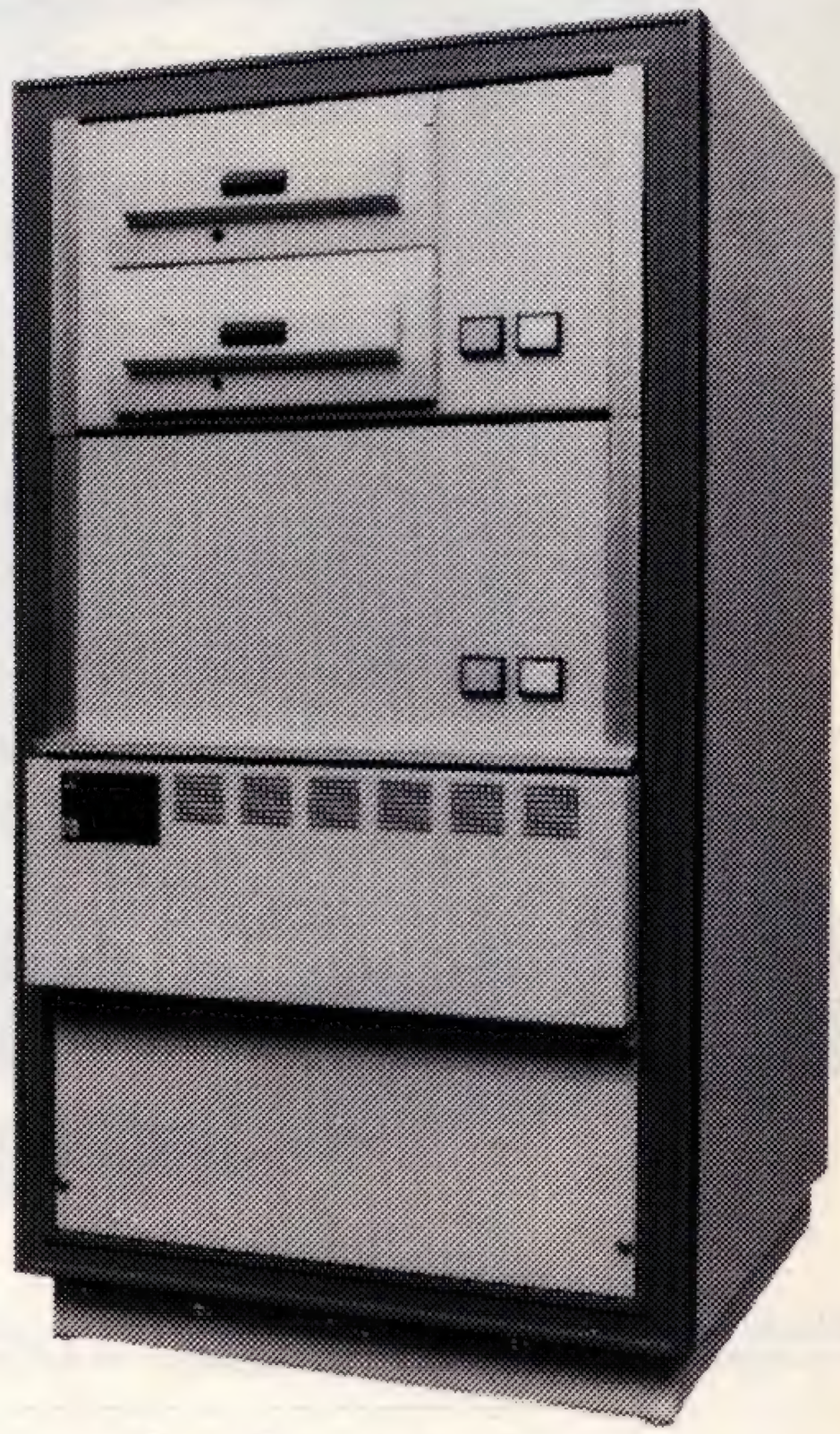
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FORTRAN FOR YOUR APPLE

NEW

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FORTRAN is a powerful programming language, especially suitable for work in mathematics, engineering and the sciences. Apple FORTRAN, usable with the Apple Language System, is the ANSI Standard Subset of the recently-defined FORTRAN 77 standard; in several areas, Apple FORTRAN contains enhanced features and capabilities.

Apple is providing FORTRAN for use by technical professionals and educators who are both familiar with the FORTRAN language and are using packages written in FORTRAN. Because FORTRAN is a well-established language, large libraries of FORTRAN programs are already in existence, particularly for engineering and scientific applications. Apple FORTRAN provides the sophisticated FORTRAN user with the capability to develop new and modify existing FORTRAN programs on an Apple. Apple does not recommend FORTRAN for the individual new to programming.

Apple FORTRAN...

- *offers enhanced features and capabilities because it supports the newest computer industry standard, ANSI X3.9-1978...*
- *provides a comprehensive software design environment including an editor, linker, file handler, assembler, Apple Pascal compiler, and system library, operating in the Apple Language System ...*
- *eliminates the need to recompile or reassemble existing code files when incorporating them into FORTRAN programs; compiled P-code and assembled machine code can be combined with a FORTRAN P-code file through the Apple Language System's linker facilities...*
- *allows you to take full advantage of Apple's Hires graphics capabilities by interfacing to graphics routines in the system library...*
- *gives programmers access to large libraries of material, since FORTRAN is a familiar, well-established language...*
- *provides access to special Apple features,such as sound generation and control paddles,through its system library routines...*
- *permits you to combine several source files in a single compilation through compiler directives in the source code.*

First, Some Words About FORTRAN '77

FORTRAN 77 contains significant additions and enhancements to the previous 1966 standard. For example, mixed-mode arithmetic expressions are allowed. Structured programming is supported through expanded IF statement constructs. Logical IF, Block IF, ELSE IF, ELSE, and END IF statements provide a vastly improved method of clearly and accurately specifying the flow of program control. CHARACTER data type replaces Hollerith, alphanumeric data can be represented as strings rather than array elements.

Some Specifics About Apple FORTRAN

Apple FORTRAN is the ANSI Standard Subset FORTRAN 77. It also supports enhancements and facilities from the full FORTRAN 77 language. In particular:

- Subscript expressions may include array elements and function calls.
- DO statement limits may be defined by expressions, rather than just single variables.
- I/O units may be specified by expressions, rather than just constants or simple variables.
- The I/O list of a WRITE statement may include expressions.
- All combinations of FORMATTED/UNFORMATTED and SEQUENTIAL/DIRECT files are allowed, with the following restrictions: —BACKSPACE is supported only for files connected to the blocked devices, it is not supported for UNFORMATTED SEQUENTIAL files; — —DIRECT files must be connected to block devices.

Apple FORTRAN contains a number of enhancements beyond the full FORTRAN 77 specifications. In particular:

- Compiler directives may be included in the source code. For instance, the $INCLUDE directive allows you to insert previously-developed code into your program without having to repeat the code. This is useful, for example, when you are writing many subroutines which use the same COMMON block. You can write the COMMON block just once, and $INCLUDE it in every subroutine.
- An additional parameter to the OPEN statement allows you to specify whether the file is blocked or unblocked.

There are two minor differences between the ANSI Standard Subset FORTRAN 77 and Apple FORTRAN. They are:

- Subprogram names cannot be passed as parameters.
- INTEGER and REAL data types have different storage requirements—two bytes for INTEGER, four bytes for REAL.

Apple FORTRAN is written in Pascal and produces P-code which runs in the Apple Pascal Operating System.

Diskettes: 16 sector format

To use Apple FORTRAN, you will need:

- Apple II or Apple II Plus, each with the Apple Language System
- Apple Disk II drive with controller*
- video monitor or television

*While a single drive system is adequate for very small programs, two drives are strongly recommended for ease of operation and more serious program development.

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apple II (MT)

APPLE II PLUS

When Stephen Jobs and Steven Wosniak launched their first APPLE II, they were far from realising the worldwise success this microcomputer would have. Nearly anything can be done with the APPLE II. Whether it be business, science, leisure or art, your APPLE II can handle it all. (We've even seen an APPLE preparing coffee lately!)

It's full expansion capabilities enable you for example to connect your APPLE II to 4 disks, 2 printers, one tape cassette recorder, and one optical pen still leaving you room for 4 other connections. Therefore your APPLE will never become out of date and will always be able to adapt to new techniques, however versatile or varied the they may be.

Two types of computers are now available:

– APPLE II: this system is supplied with INTEGER BASIC, high resolution graphics routines, mini-assembler, disassembler and system control firmware in ROM. Demo programs and manuals are oriented around INTEGER BASIC.

– APPLE II PLUS: this system is supplied with APPLESOFT extended BASIC (including high resolution graphics routines), disassembler and new auto-start system control firmware in ROM. Demo programs and manuals are oriented around APPLESOFT extended BASIC.

Integer Basic or Applesoft Basic are available as plug-in card options for 110. – each.

Both APPLEs are based on the 6502 microprocessor, they include: sockets for up to 48K RAM, 8 peripherals board connectors, speaker, two hand controllers, cassette interface, colour graphics hardware, I/O connectors and typewriter style ASC II keyboard.

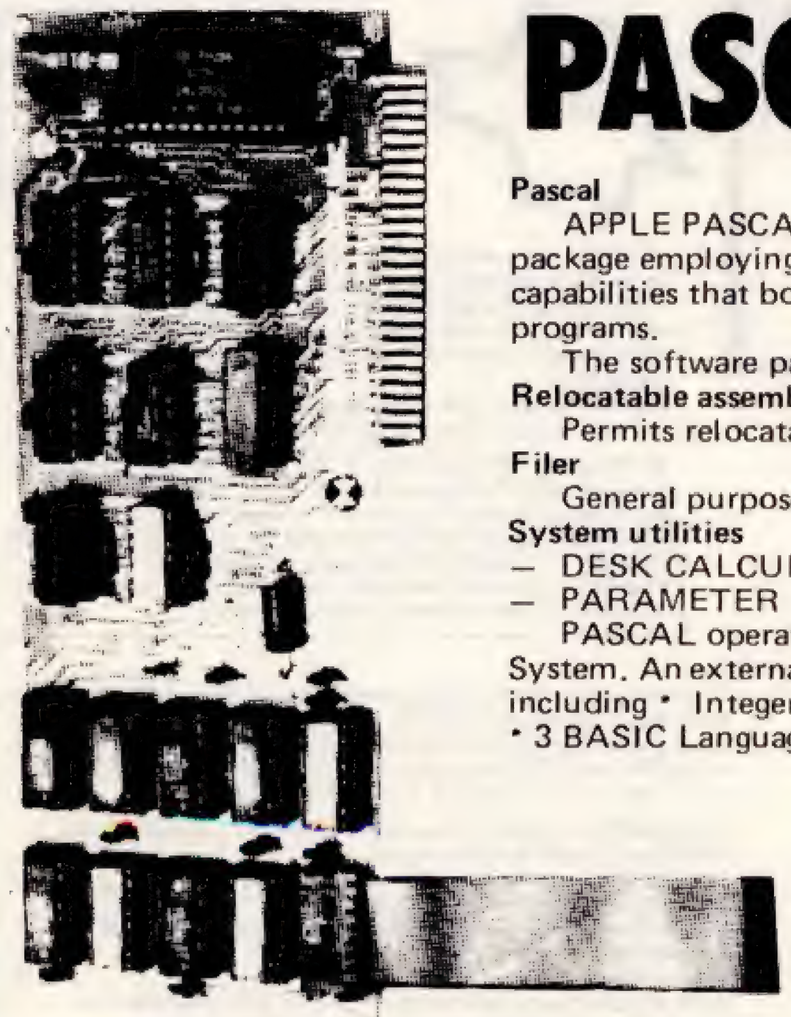


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Pascal

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The software package provides a powerful set of tools for the serious programmer:

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Permits relocatable assembly language routines to be generated and linked to PASCAL programs.

Filer

General purposer program for manipulating all system disk files.

System utilities

– DESK CALCULATOR – performs basic calculations

– PARAMETER – allows examination and modification of system operating environment.

PASCAL operates in a 48K APPLE II or II Plus with one to six disk drivers and the APPLE Language System. An external 80-column terminal can be attached. The package includes: • Language Card • 5 diskettes including • Integer BASIC • Applesoft Extended BASIC • PASCAL System • JC puller • 3 PASCAL manuals • 3 BASIC Language manuals • Installation & Operation manual

£230 + VAT

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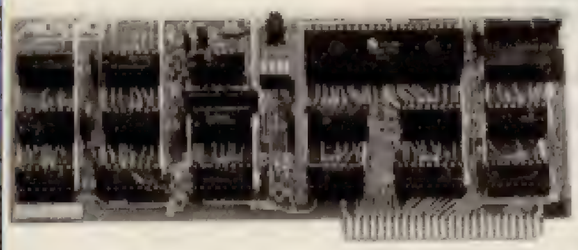
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Literally thousands of CP/M based applications can be easily transferred to run on the Apple. It is simply a matter of converting programs from standard 5" and 8" CP/M disk format into CP/M disk format. This is done by transferring CP/M files from a CP/M machine to the Apple via a serial I/O port. You'll need an Apple High Speed Serial interface or an Apple Communications interface; a connecting cable; and, of course, a CP/M machine from which to transfer. Utilities that make this process easy are supplied with the Z-80 SoftCard.

USING PERIPHERAL WITH THE Z-80 SOFTCARD

A Z-80 SoftCard system will run with all standard Apple peripheral I/O cards and most independent peripherals including any printer that is supported by Apple printer interface cards. Since CP/M provides the same I/O environment as Apple Pascal, a good rule of thumb is that the SoftCard will interface with any peripheral that currently works with Apple Pascal.

The Z-80 SoftCard will support up to six disk drives. 24 x 80 column video cards such as the Videx and Sup-R-Term are supported as are most popular 80 column terminals such as those from Hazeltine and Soroc.

In addition, user I/O drivers can be easily added to CP/M.

WHY CP/M?

Next to the SoftCard itself, CP/M is the most important key to allowing a wide variety of Z-80 software to run on the Apple including version 2.2 of the CP/M operating system in the SoftCard package.

More soft-ware choices for the user. You have your choice of many sophisticated system, word processing, accounting, business and professional software packages when you have CP/M.

Unlike standard Apple DOS, CP/M supports many languages in addition to BASIC. These include FORTRAN, COBOL, BASIC Compiler.

And CP/M has many conveniences not found in Apple DO8. Such as easy interface to machine language programs; faster disk 1/0 simple file transfer; and wild card file-narning conventions that allow you to refer to multiple files with one name.

Included as standard with CP/M 2.2 is a complete set of system utilities that give you complete control of the CP/M operating environment. These include PIP, a general purpose file transfer utility and STAT, a program that lets you keep track of important system information such as disk space and file size. SUBMIT and XSUB allow you to execute batch processing jobs. And a powerful text editor, assembler, and sophisticated assembly language debugger, are also included.

The Z-80 SoftCard is not an emulator. It is an actual Z-80 chip plus interfacing circuitry on a circuit board that plugs directly into any of the slots on your Apple (except slot 0).

The Z-80 does not replace your 6502; it adds to it. You use Z-80 mode when you want to run Z-80 software. Switching back and forth is simple.

When you are in Z-80 mode, the Z-80 assumes all the processing tasks, but the 6502 continues to handle I/O. Thus, you can still use most Apple peripherals when you are in Z-80 mode.

MEMORY REQUIREMENTS

To run the Z-80 SoftCard requires a disk-based Apple II or disk-based Apple II Plus computer with at least 48K RAM memory. If used with a Language Card, 12K additional RAM can be utilized.

Whether you have a 48K system or a 60K system with Language Card. 4K of RAM is required to handle the Apple screen and CP/M sector read and write routines.

CP/M occupies 7K of RAM, 2K of which can be used by other programs, such as BASIC. The standard versions of Microsoft BASIC, which supports all Applesoft extensions except high-resolution graphics, requires slightly more than 24K RAM. So BASIC and CP/M together occupy just over 29K RAM.

The version of BASIC that supports high-resolution graphics is somewhat large because 8K of screen memory is necessary for high-resolution graphics. It occupies just over 33K, making a total of slightly more than 38K for both CP/M and the high-resolution version of BASIC.

BEYOND MICROSOFT BASIC

Microsoft 5.0 BASIC is provided with the Z-80 SoftCard. Microsoft FORTRAN, COBOL, BASIC Compiler, and Assembly Language Development System will be available and sold separately to Z-80 SoftCard users.

Just imagine the power of your Apple Computer when it has one of the following:

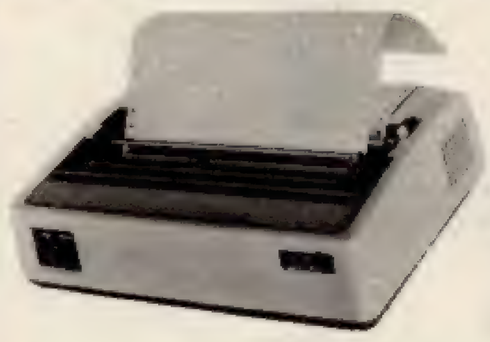
Microsoft FORTRAN-80. Comparable to the FORTRAN compilers used on large mainframes and mini-computers. Microsoft's FORTRAN-80 brings the world's most popular science and engineering programming language to the Apple. Compilation is very fast (up to several hundred statements per minute) and less than 25K bytes of memory are needed to compile most programs. All of ANSI FORTRAN X3.9-1966 is included except the COMPLEX data type. Therefore, you may take advantage of the many application programs already written in FORTRAN.

Microsoft COBOL-80. The most widely used language for business applications, COBOL is excellent for inventory, personnel, payroll, order entry, accounting and forecasting applications. Powerful use of disk files, CRT screen handling, easy-to-use syntax and readable programs give programmers the tools they need to meet the rising challenge of data processing. Microsoft's COBOL-80 is an ANSI standard COBOL with many enhancements.

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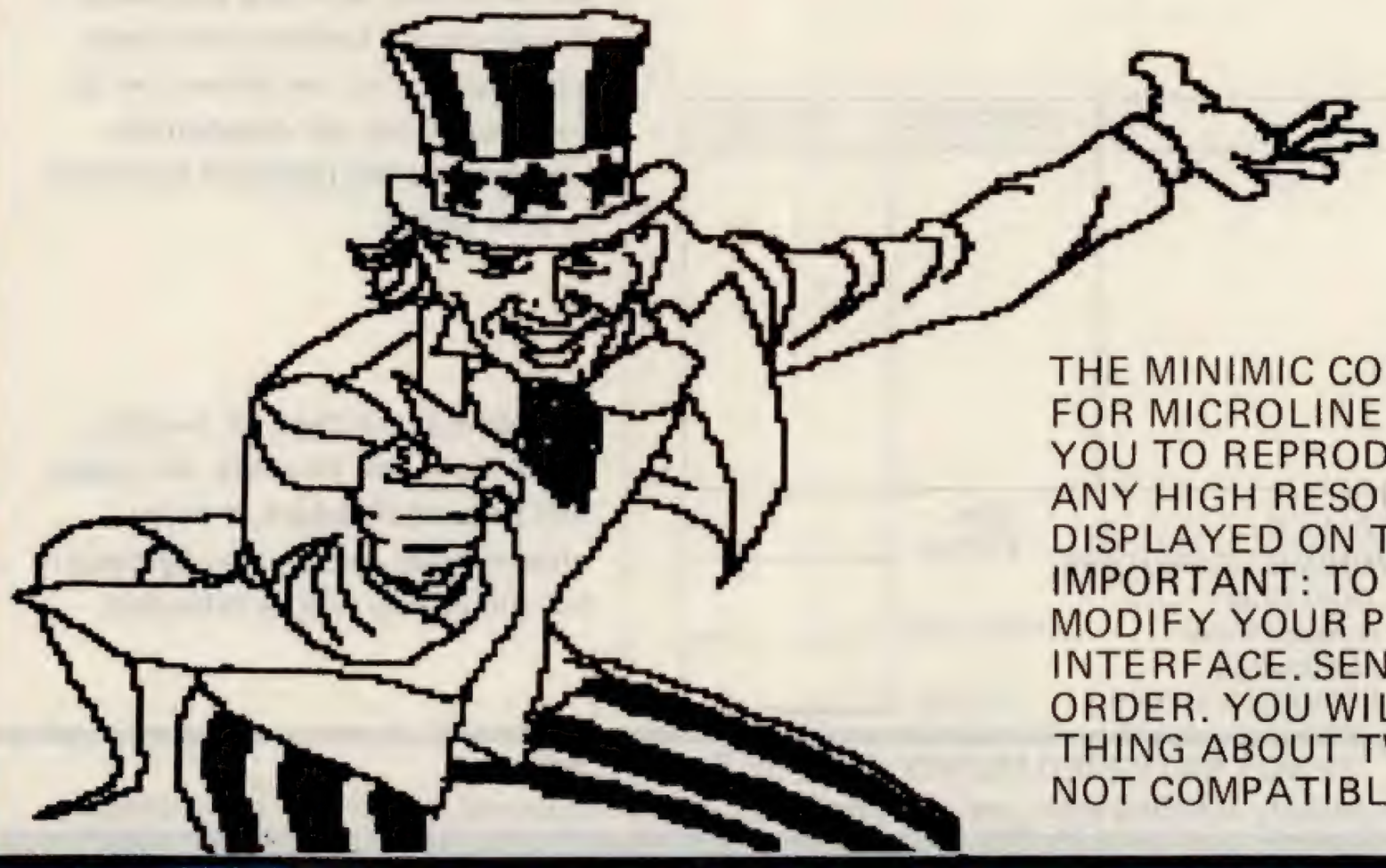
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Hard copy, Microline 80 and APPLE with disk

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Hardware & Software



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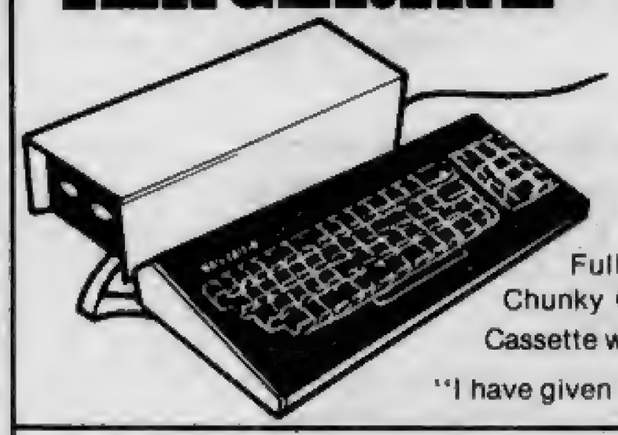
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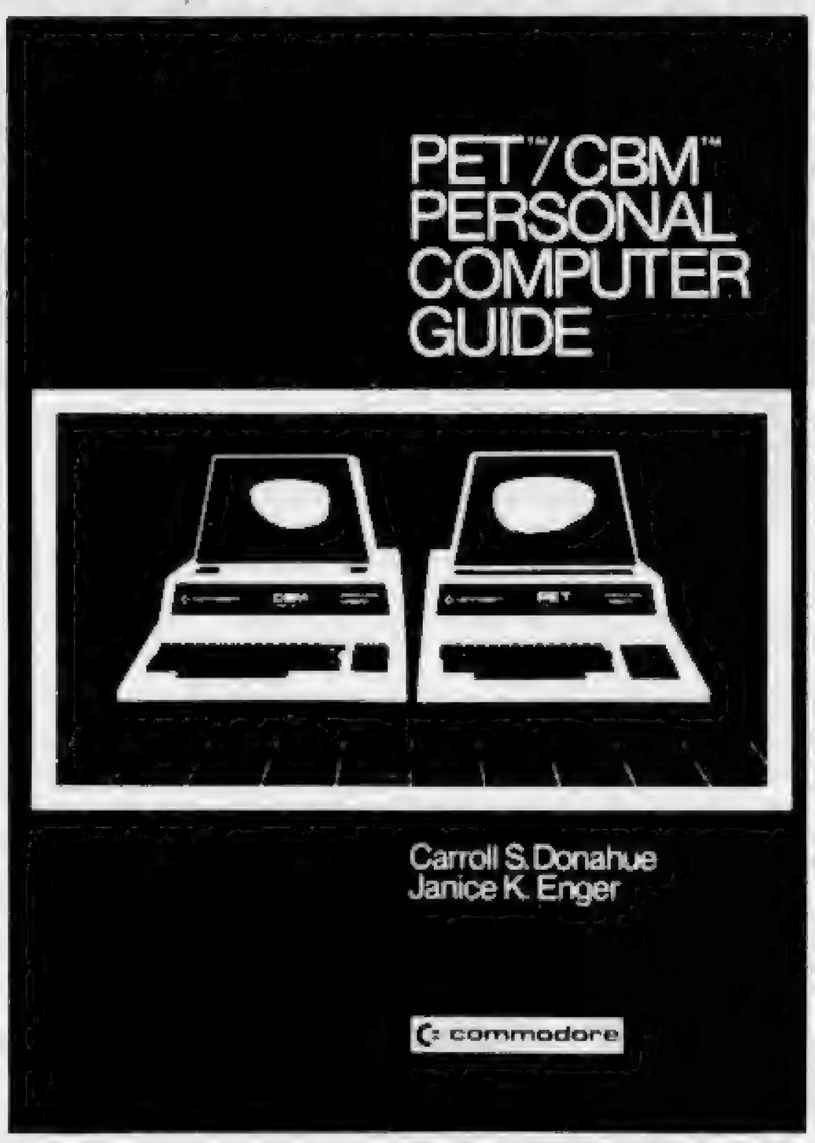
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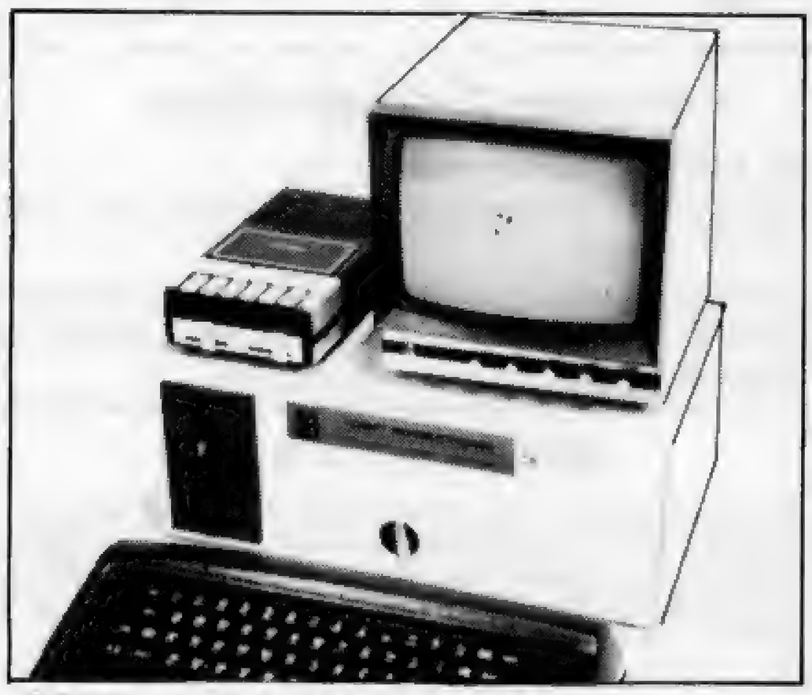
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SPECIFICATIONS

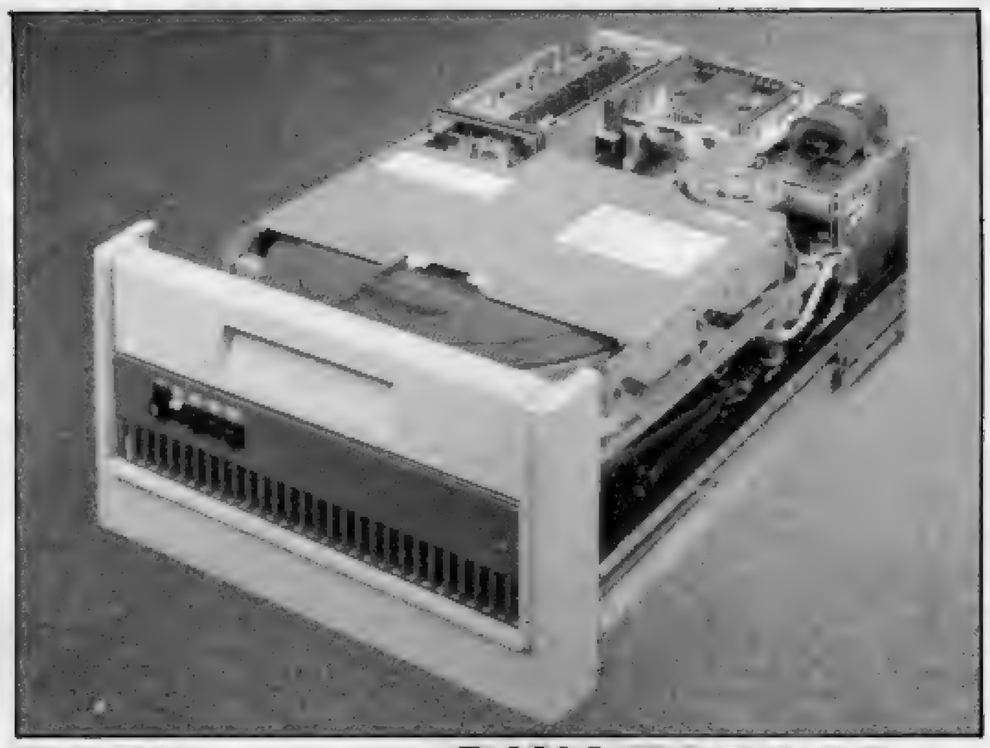
Plotting area	: 360mm x 260mm
Maximum plotting speed	: 50mm/sec (axially)
Programmable step size	: 0.1mm (internal interpolation in 0.05mm steps)
Distance accuracy	: Within 1%
Repetition accuracy	: Within 0.3mm
Pen type	: Hard fiber-tip (max. weight 7g)
Power supply	: 100, 110, 120, 200, 220, 230, 240 VAC ±10% (50/60Hz)
Power consumption	: 70 VA max.
Operating temperature	: 5°C ~ 35°C
Relative humidity	: 35% ~ 75%
Recording paper	: Max. size 420mm x 300mm (A3 size)
External dimensions	: 600 (W) x 520 (D) x 95 (H)mm
Weight	: Approx. 13kg

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6 = Tested and debugged in many installations world wide.
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10 = Core program means your main drive is ***free ***for data
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13 = Reference on invoices enable cost centre build-up on ledgers.
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As prices vary from dealer to dealer we append for your guidance, some details of the justification in our prices being higher than the cash/carry concept of trade.

A standard Superbrain 64K *320K Disk at 1795.00 includes the following values not normally expected at the lower price.

1) Equipment is burned and tested for a minimum 48 hours
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3) All goods & software are stocked on immediate delivery
4) 6 month main unit, 12 month memory guarantee
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9) Positive before **and **after sales service

If the transaction includes a printer and the business programs then the following are also added:

10) All cabling between printer and Superbrain free (25.00)
11) Ribbon and thimble free (eg: Spinwriter 4.75 + 9.75)
12) Extra 10 Diskettes free (28.50)
13) Additional free software based on 10% of printer value
14) Free training session plus all necessary follow up
15) Box printer paper (28.50)

A typical deal could look like this:

Superbrain	1795.00
NEC Spinwriter	1695.00
	3490.00

BUS Program 775.00 plus Basic 150.00 (less 349.00) = 576.00
Total Purchase Price 4066 plus V.A.T.

The total value of free items on this deal was in excess or 500 pounds in virtue of incidental items as well as extended warranty and software.

Do consider your purchase on the basis of some of the things you may be likely to need after your equipment purchase, and may either fail to obtain because the dealer has no stock or has lost interest in you, or because you aimed at the short term gain in price and are then compelled to pay heavily for small needs afterwards.

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03=*ENTER A'C RECEIVABLES
04=* ENTER PURCHASES
05=*ENTER A'C PAYABLES
06=*ENTER'UPDATE INVENTORY
07=*ENTER'UPDATE ORDERS
08=*ENTER'UPDATE BANKS
09=*REPORT SALES LEDGER
10=*REPORT PURCHASE LEDGER
11=*INCOMPLETE RECORDS
12=*USER DBMS AREA
13=*PRINT CUSTOMERS STATEMENTS
14=*PRINT SUPPLIER STATEMENTS
15=*PRINT AGENT STATEMENTS
16=*PRINT TAX STATEMENTS
17=LETTER TEXT AREA
18=ALTER VOCABULARIES
19=PRINT YEAR AUDIT
20=PRINT PROFIT'LOSS A'C
21=OPEN AREA
22=PRINT CASHFLOW FORECAST
23=ENTER PAYROLL (NO RELEASE)
24=DISK SWAP'EXIT

. . . . . ENTER WHICH ONE?

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INSTANT SORT/SEARCH DATABASE

Everything in electronics takes a finite time, consequently nothing can be instantaneous. However a database that will search 500 records and sort the names into alphabetical order in 1½ seconds, that will go on to do the same thing with 1,000 names in only 2½ seconds, is fast. If you add that ability to search 500 or 1,000 records for a specific range of names or ages or sexes or whatever, in such a small amount of time that it is not worth timing it, then the program deserves to be described as instantaneous. Especially as these times are attained on a standard Level II TRS-80.

These results are achieved, obviously, by some very clever machine language coding. This however is not enough. After all GSF from Racet will sort 1,000 arrays in about 11 seconds and that is indeed a clever program. No, in order to achieve the results required from this program it is necessary to change one's entire overview of database.

There are many databases available for the TRS-80 now. All of them have been designed to store as much data as possible, as easily as possible. Not as an afterthought, but nor as a prime design requirement, they have also incorporated as fast a sort as was practicable. This program was designed from the outset to achieve unbelievably fast sort and search times. Indeed we do not recommend this database for application in which fast searching or sorting is not a prime requirement. And what are the applications? It's a hackneyed phrase to say that they are limited only by the user's imagination, but that's about it. Let's take an example. Suppose you are running a marriage or data bureau. An ordinary database will file all the names and addresses away together with the necessary information as to sex, age and so on and with some you would be able to sort the list, so that only people with similar characteristics were eventually obtained. With this database you could, for instance, file the name, sex, age, category of hobby, category of chief interest, vital statistics and other data so that at the touch of a button you could instantaneously display on the screen all women of a certain age with certain vital statistics, living in a certain area. You could also display men with similar (excluding the vital statistics!) data that fall into similar categories. And all of this almost instantaneously. Not everybody runs a marriage bureau, but other applications are not hard to think of. Estate agents can file details of property away so that they can instantaneously obtain data on houses in a certain area or of a certain size. Doctors can reach information as to patients with similar diseases, ages or whatever immediately. In the home, a record library can be stored and every record by a certain composer written in a certain year can be accessed without delay. The list of applications is endless. For any use where it is important to extract information within a certain range or it is important to sort information, this database will find a use.

The prime commands and features of this program are as follows:

Datafile creation

1. Create a file.
2. Add a record.
3. Delete a record.
4. Display a record.
5. Tape a file.
6. Amend a record.
7. Display the file data.
8. Load a tape.

Sort/Search

1. Sort up or down.
2. Page forward or backward.
3. Select a range for search.
4. Select or exclude a category.
5. Select or exclude on initial letter.
6. Resort records in a sort.
7. New sort all records.
8. Extended sort.
9. Arithmetic.
10. Display file data.
11. Load a tape.
12. Printout sorted data.

The data is displayed in columnar form and the data may be alphabetical, alphanumeric, integer or decimal. The number of columns is from 2 to 10 and the records may contain a maximum 44 - 60 characters depending upon the number of columns used. Columns may be of any width within the screen capacity but integer or decimal columns more than five and six characters wide respectively will not have the option of searching within a range.

The program consists of two parts. The first is used for entering the data and the second for the sort or search. The second part overlays the first when it is loaded so only 4K of memory is used by the entire program. The remainder of your memory space is available for data. The amount of data that can be contained will of course depend upon the amount of memory available, but as a rough guide a 16K user will be able to manipulate at one time 250 records of 39 characters each or 514 records of 17 characters each. As a further rough guide on sorting speed, the time to sort 1,000 records on fields of random strings of random length, or of random number between 1 and 99,999, averages under 2½ seconds.

Numeric columns either integer or decimal may be arithmetically manipulated almost instantaneously. A total may be cast or an average taken for any numeric column up to five digits. This is so fast that when adding 1,000 numbers totalling over 50 million, only a slight hesitation can be noticed before the total is given.

In summary therefore this program is ideal for any application concerning the manipulation of information whether it be business, personal or hobby which can be comfortably displayed as one record per line upon the screen and in respect of which it is required that super fast searches or sorts be carried out. The program is supplied on cassette. At this time it is not compatible with disk systems. A disk version is in the course of preparation. The cassette includes a set of data randomly generated which can be fed into part 2 of the program to demonstrate the fantastically fast sort and search features.

Tape for 16K TRS-80 or video genie **£19.50**

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SUPERSCRIPT

SuperScript is a series of machine language programs which will permanently customise Tandy's Scripsit to a user's own requirements, particularly as to his printer. It also adds a number of enhancements to the original Scripsit program. The program includes a number of features which we do not have space to list here, but the three principal ones are that the user can now access the Disk Directory from within SuperScript, listing all files and the number of free granules on the diskette. Files can be killed from within SuperScript so as to make extra space to fit in a large text file. The third and perhaps the most important enhancement is to permit almost any printer to be used with Scripsit. It includes eight driver routines for both serial and parallel printers and these include utilities to enable the user to sculpture a customised serial or parallel driver to his own particular requirements. If your printer will backspace then underlining and slashed zeroes are options. Dedicated drivers in the package are for Diablo parallel and serial, NEC5330 parallel and serial and two general purpose drivers.

Disk for minimum single drive 32K machines **£19.50**

DUEL-N-DROIDS

A "second generation" Android Nim. Leo Christopherson has done it again! Two androids battle it out before your eyes with laser swords! There are two forms of play. In the first the player controls one android and the computer the other. The player must achieve a certain rank of skill as a swordsman to enable the android to go on to fight a tournament. The player's android is controlled by four keys and the higher the rank that the player can attain the better the chance that his android will beat the computer when it enters the tournament. Tournaments are of two types. In one, the player's android is pitted against an equally ranked android controlled by the computer. In the other the player's android fights against androids controlled by the computer of random ranking. Android Nim by Christopherson created something of a revolution in microcomputer games and Duel-N-Droids follows on in this same tradition. Excellent sound is provided in the program.

Tape version 16K TRS-80 or video genie .....**£9.50**, Disk version 32K one drive **£12.50**

BASKETBALL

Another highly graphically orientated machine language action game with sound. Each game lasts four minutes and either two players take part or one player plays the computer. The graphics are based on a three dimensional depiction of a basketball court on which there are two players. One is controlled by each human player if two are playing, or when a human player plays against the computer the home player is controlled by the computer. The appeal of the game is its realism. The court player may be controlled in one of four directions, may dribble and shoot for the basket. The player who scores the most baskets in the four minutes of play wins the game.

Tape version 16K TRS-80 or video genie .....**£9.50**, Disk version 32K one drive **£12.50**

QUAD

Quad is three dimensional noughts and crosses. As its name implies, it is played on a cube of four layers each with four ranks. Like noughts and crosses the aim of the game is to get crosses or noughts in a line either horizontally, vertically or diagonally. The cube is depicted graphically on the VDU and either two players may take part or a single player may play the computer. Four levels of difficulty are provided and a time clock is also included for each move. A particularly important feature of the game is that the cube on which the game is played may be rotated so that the player can see it from a different angle. A number of commands are provided including setting up previous positions, backing up to a previous position, progressing to the next position, reversal of order of play and switching of opponents. This is a complex game of strategy in which the player will need all of his skills.

Tape version 16K TRS-80 or video genie .....**£9.50**, Disk version 32K one drive **£12.50**

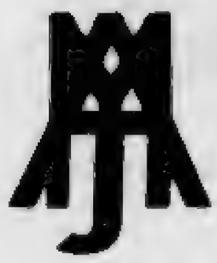
CODE BREAKER

Code Breaker is a logic game with sound effects. It is not necessary to describe this program in great detail because it is essentially a computer adaptation of the well known logic game Mastermind. The object of the game is to determine with as few moves as possible the colours and positions of four secret code pegs. For each move the colour and position of four pegs is chosen and the response of the computer is with a black, white or pink peg in respect of each position of the player's peg. These three colours have different meanings and from their positioning it is possible to logically deduce the position of the hidden pegs. The program features sound effects and a graphic layout of the code pegs.

Tape for 16K TRS-80 or video genie **£6.50**

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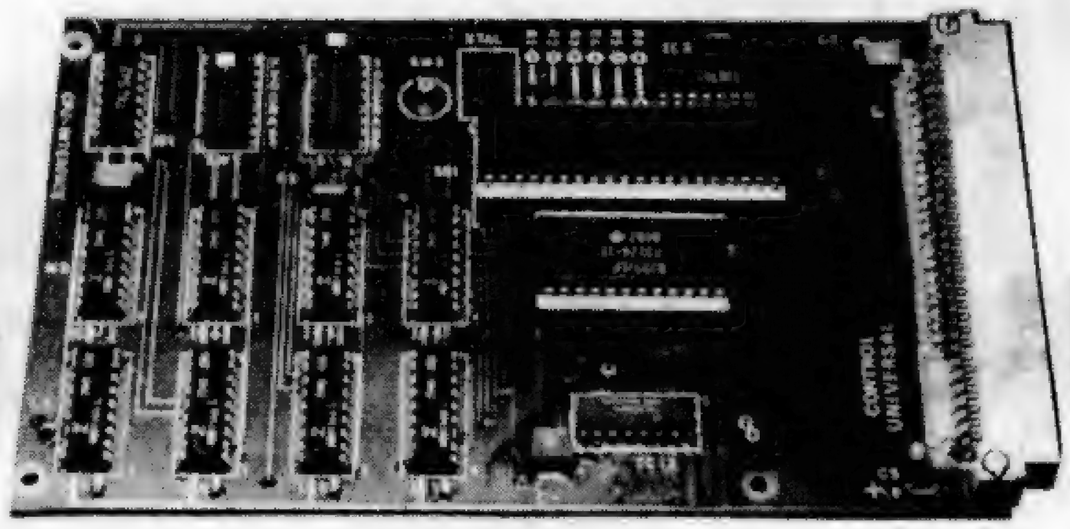
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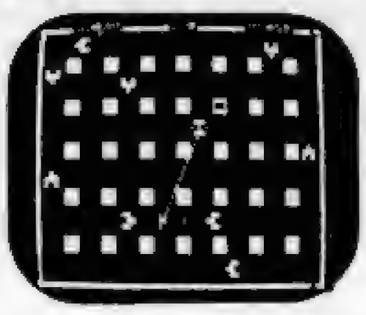
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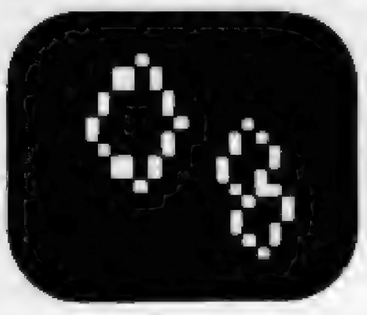
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Dodge the alian Ramships and fire missiles to destroy them before they get you. The alien Flagship uses his deadly laser bolt to transform a Ramship into another Flagship or into your ship's double. Look out!! Destroy your double and you could destroy yourself.
TRS 80 Level 1 or 11.16K Tape £10
Hours of exciting fun.

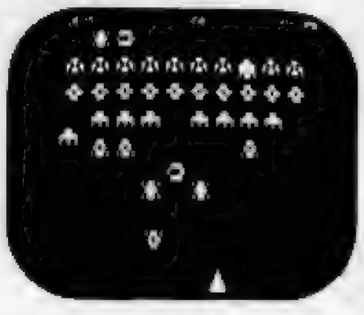
NEW

ASTEROID NOVA



For the first time the amazingly popular ASTEROIDS pub game is now available for your microcomputer. Huge asteroids have invaded the galaxy. Your mission is to destroy them and the alien saucers before they destroy you. But beware, big asteroids break up into smaller ones.
TRS80 Levels 1 & 11.16K Tape £10
Video Genie 16K Tape £10
Apple 11 or 11+32K Disk £15

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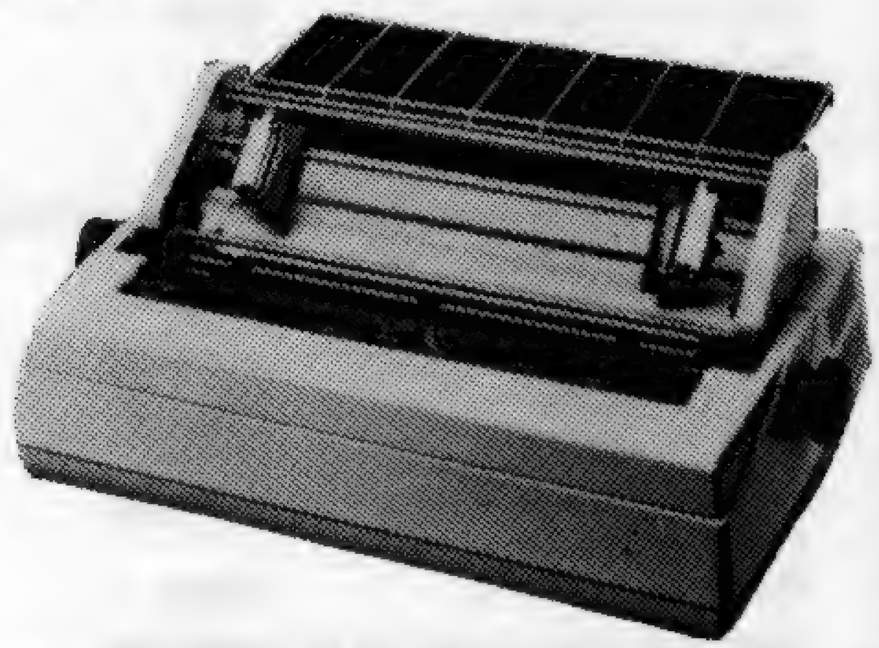
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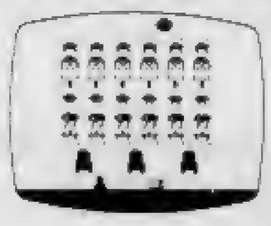
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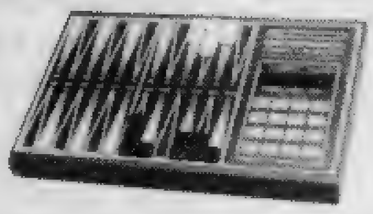
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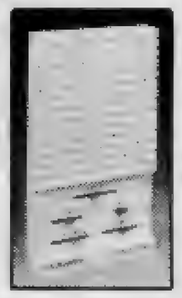
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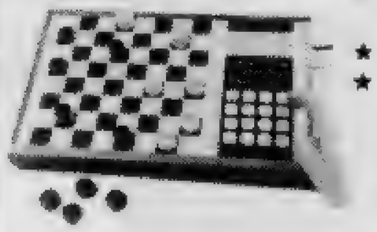
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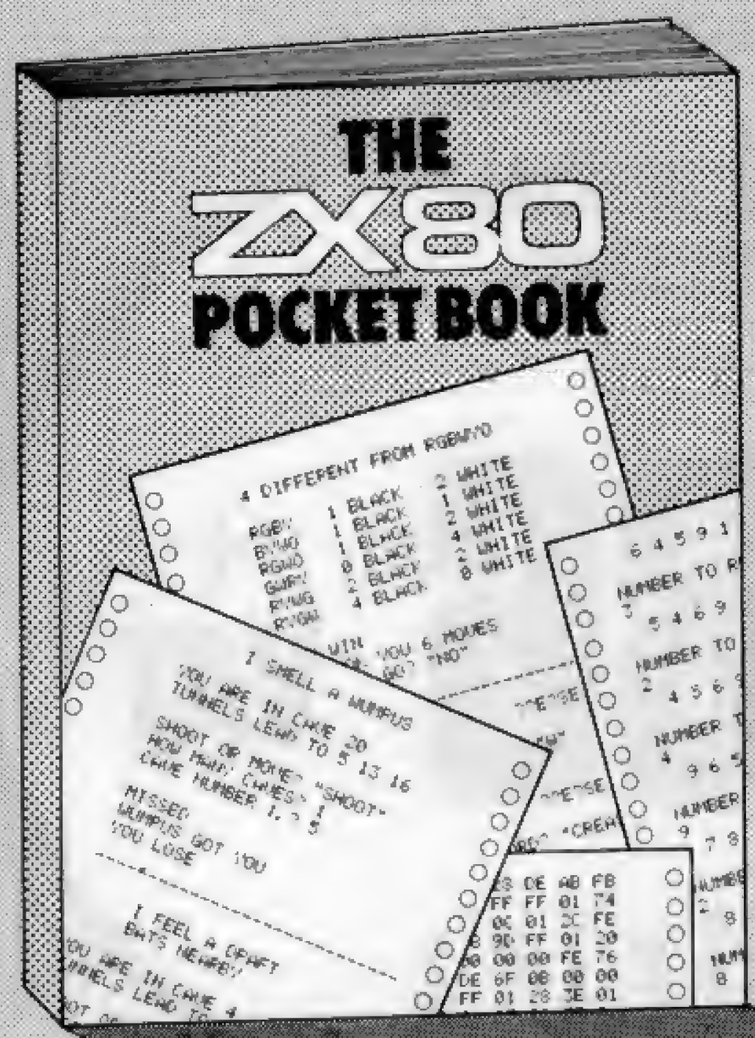
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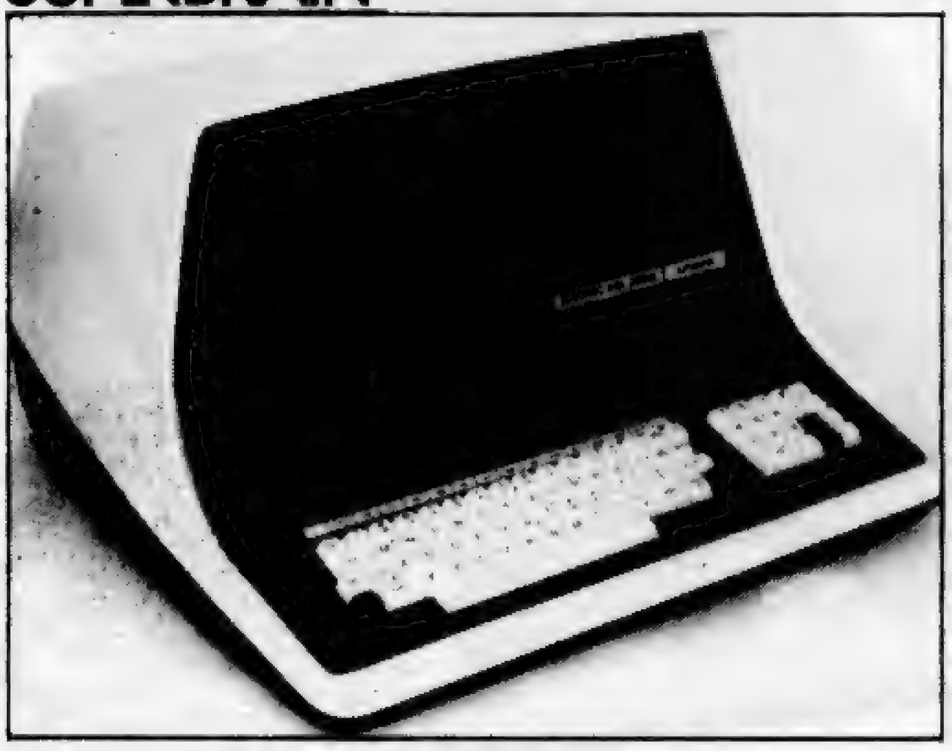
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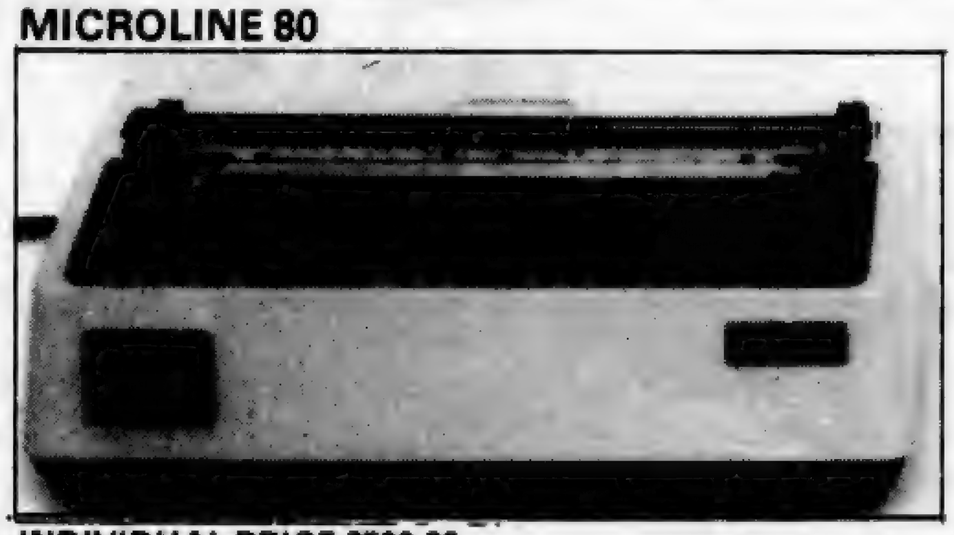
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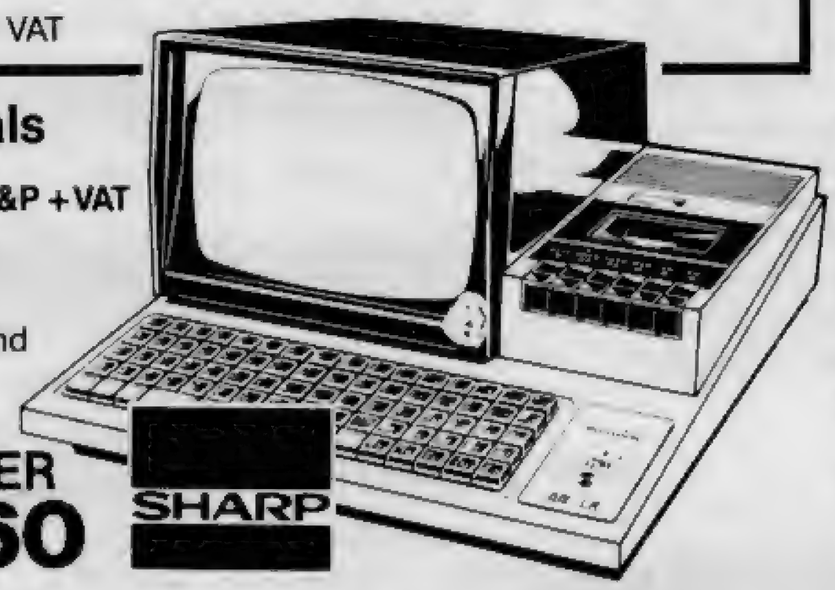
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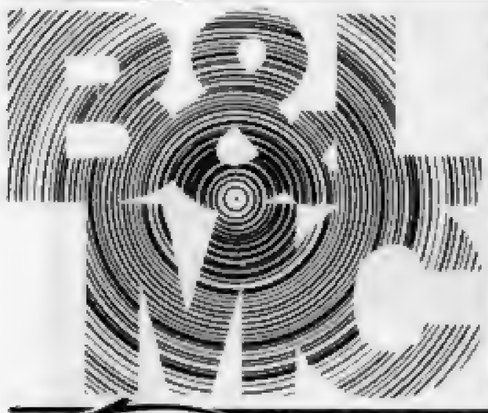
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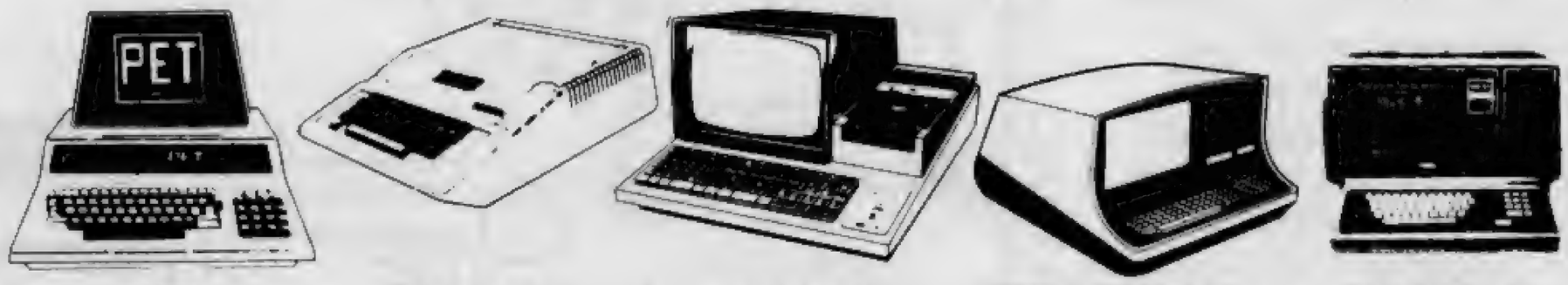
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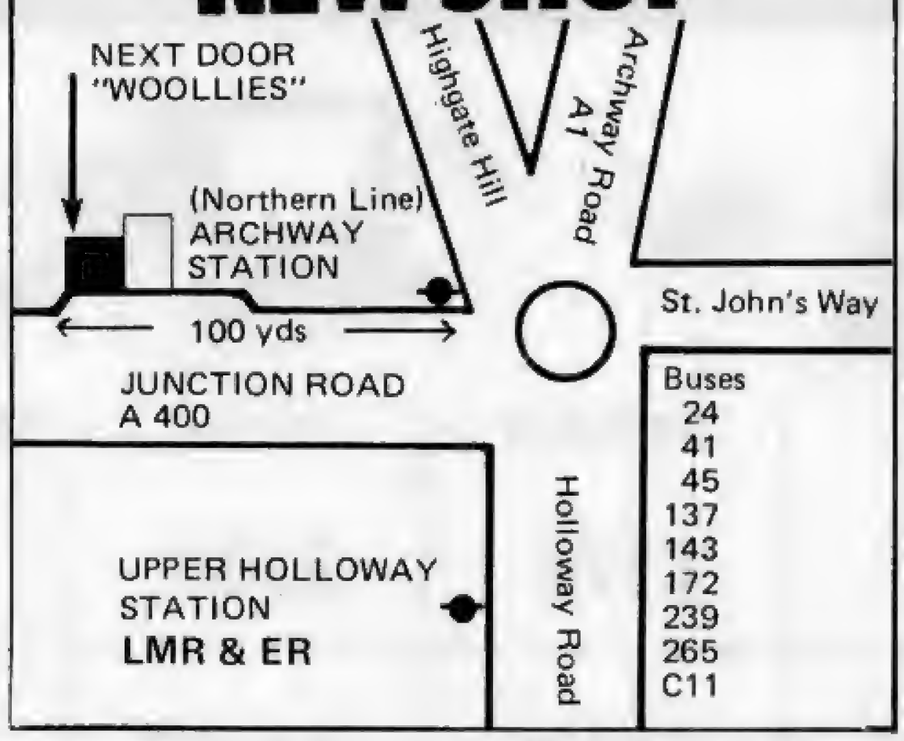
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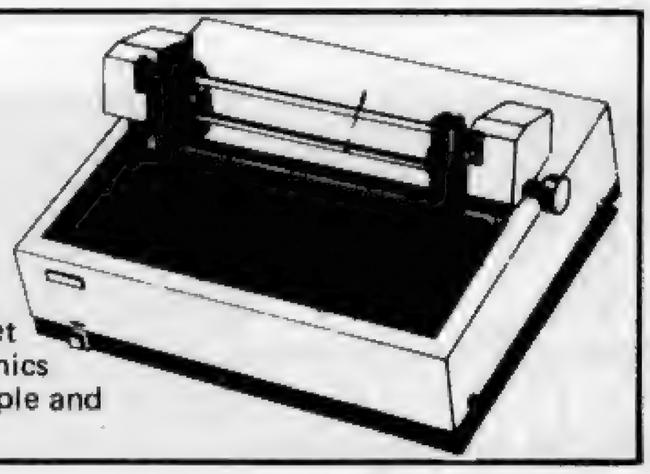
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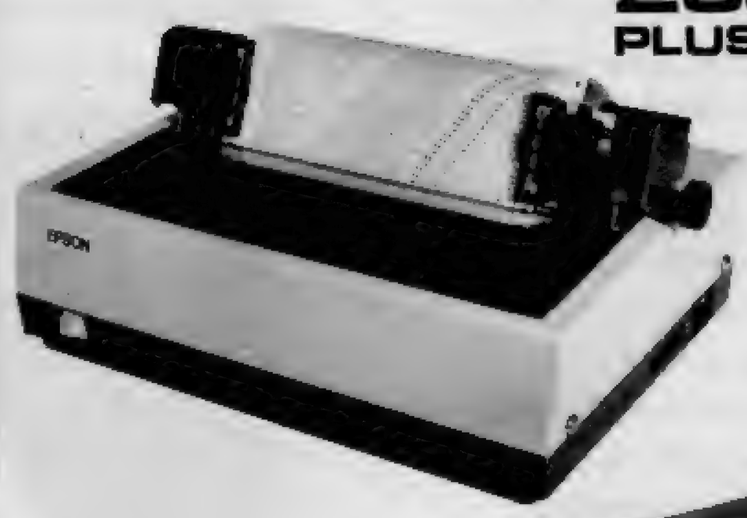
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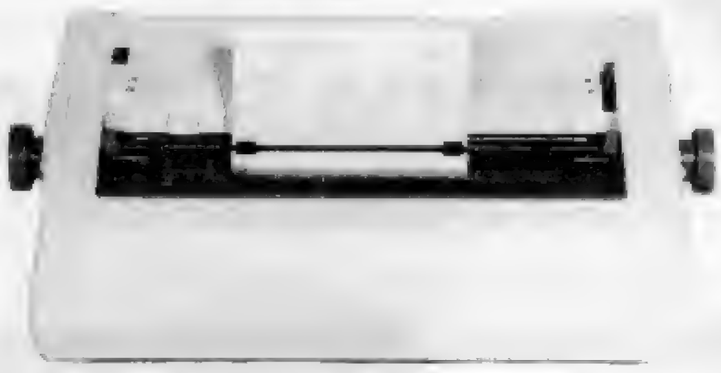
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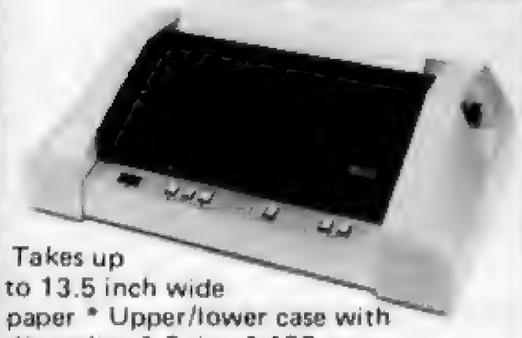


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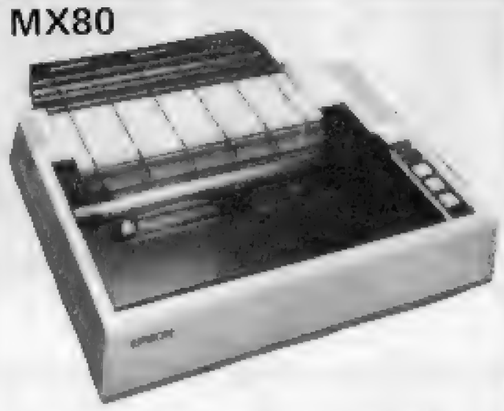
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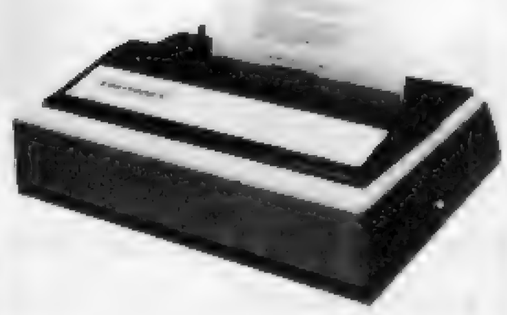
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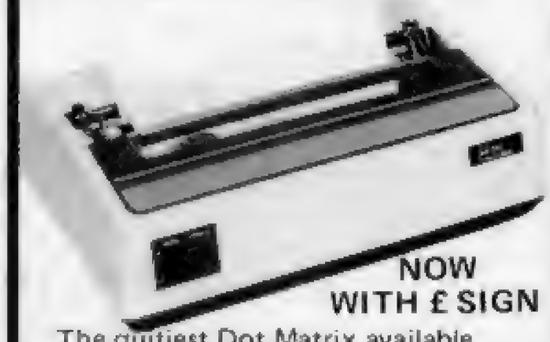
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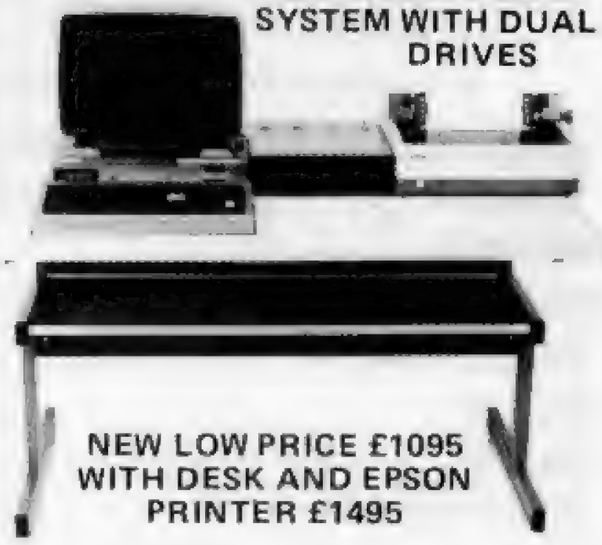


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NEWSPRINT

Guy Kewney, editor of Datalink, reports on the latest happenings in the micro world.

Give us a ring

Take a class of 30 children and buy them a nice computer — say a PET or Apple or Tandy or Acorn or Nascom — and what have you achieved? You have absolutely fascinated one child for one period, that's what.

All the rest are bored solid after the first ten minutes, waiting for their turn at the keyboard. And for most of the time they are waiting, child number one is stolidly entering phrases like "50 GOTO 60" and going back to change that to "50 GOTO 30" ten minutes later. The only way to run a class of computer students is to give them at least one machine between three (assuming you're not a university which can afford one each). I know — I've been in classes like that.

Even at the cost of the Acorn, £150 ready built, we are talking about an absolute minimum of £1500 before we buy our monitors and cassette recorders. If we want disks and PETs, we're up to the £5000 level for the machines and the same again for data storage.

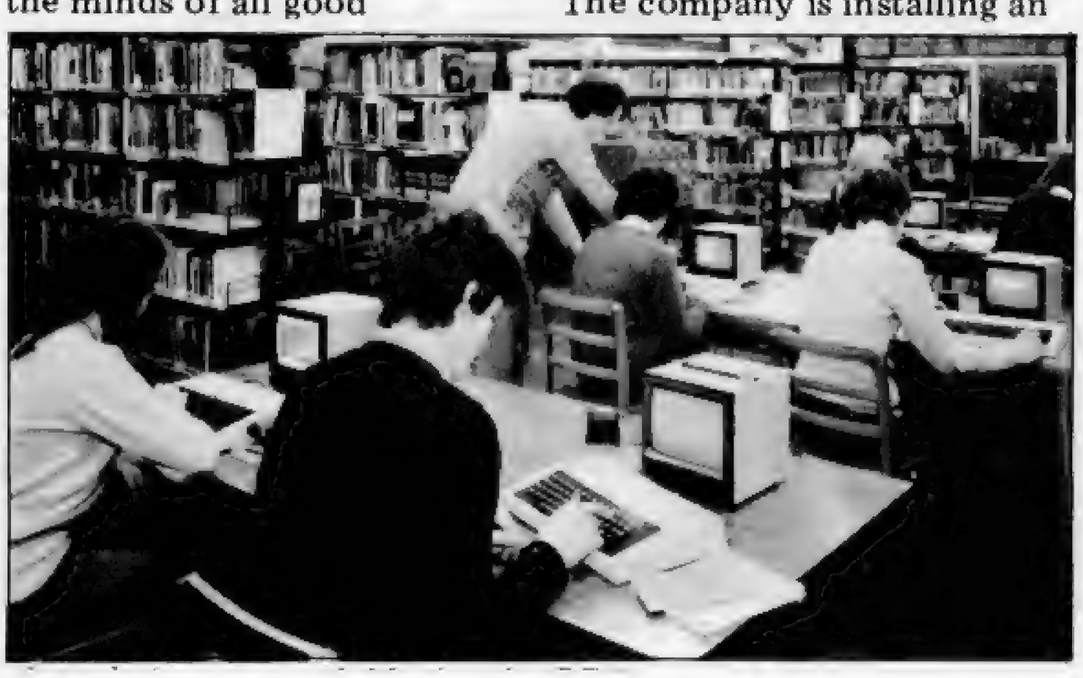
It is when you look into the costs of disk storage on this scale that you see why Acorn has agonised so long about its Econet, which connects a lot of Atoms together and allows them to share a single disk and a single printer.

The idea isn't unique to Acorn — a net of Apples has been built by Zynar (under licence from the inventor, Nestar in California) and 'local area networks' are on the minds of all good designers today.

What makes the Econet so interesting is the low cost of each keyboard. Assuming ten Atoms in the classroom and assuming that video displays have been found at around £50 each (old tellies will do), then the network and a disk brings the cost to about £300 per 'work-station'. In the classroom, once the network starts working, it looks even better. The program for the day can be loaded once — by the teacher — into every machine simultaneously, from disk (compare that with loading from tape, moving from one machine to the next — it would take the whole period to load the same program into ten machines). And if something goes wrong, any machine can watch what is going on on the screen of any other and can intervene if necessary.

Mind you, this last feature is in serious need of some modification. As things stand, if you know the network number of somebody else's machine, it is a simple matter to say *REMOTE 220 and to stop whatever that machine is doing, turning it instantly into a duplicate of your own. How to lose friends and editors — I did it to the Editor of *PCW* at the demonstration and he pretended to laugh.

Acorn is, according to Herman Hauser and Chris Curry, entirely aware of the need for market trials before the system is finally released. The company is installing an Econet itself, 'to save having to buy a second printer,' and another pre-production network is going into a local school near Cambridge.



It was an interesting demonstration but unfortunately it gave David Johnson-Davies the chance to buttonhole me and show me that the Acorn Atom can, in fact, draw pictures without covering the screen in snow: 'noise-free graphics', as he calls it, can be done.

He also glowered disapprovingly at me when I suggested that the floating point add-on should not give 3^3 as 26.99999999. . . but as 27. 'You feel it should be rounded up from the binary?' he asked me loftily. Well, yes. Any pocket calculator can do it, so why not the Atom?

The captain does a U-turn

It isn't right to gloat, so please restrict yourself to a smallish, rather wry smile at the news that Zilog has decided to 'provide systems with the popular CP/M operating system', as their announcement stiffly puts it. It's a bit like the BBC must have sounded when it finally caved in and launched Radio One.

Zilog makes microprocessors and has always prided itself on knowing how to do things rather better than others. Its Z80 processor, for instance, was designed to do all the things that Intel's 8080 could do — and quite a few more — and faster. And, naturally, it has an operating system, for getting information off disks and back on again, which is much better than CP/M — at least, Zilog thinks so. 'By implementing CP/M on their systems,' says the announcement, 'Zilog are offering micro users a unique choice — in RIO, a highly professional operating system, superb for development work, and in CP/M, a widely known operating system for which a vast amount of high level languages and applications software is available.'

Quite so: one notices how CP/M is not described as 'professional', nor does Zilog dwell on the vast amount of languages available on RIO and one is pleased that it has at last seen the light; perhaps one tries not to recall how scornful Zilog has been of us 'hobbyists' in the past.

That is not to say that Zilog CP/M (at £150) doesn't still have a few things in it designed to make sure that, while CP/M users may join Zilog because it is there, at least Zilog RIO users will not be seduced away.

It is the extras that do it. 'As might be expected,' says the company, 'Zilog CP/M has some unique features.' This means that if you use the real-time clock, or the interrupt driven control, or BIOS source containing drivers for several printers and try to switch to someone else's CP/M, you will find that they are incompatible. Not to worry; at £3200 for a 64 kbyte system including video, twin full-size disks and operating software (both RIO and CP/M) Zilog is at last offering an MCZ system that is actually cheaper than some only moderately overpriced 'hobbyist' systems. Now, will Intel ever unbend? Zilog is in Maidenhead on 0628 36131.

Monopoly magic

I have a friend (*! — Ed*), a small elf called Marvin, who is a Level II magic user and thief. When he is not wandering around a dungeon with a couple of priests, footpads and armed heroes, he is a computer consultant called Richard, an expert on viewdata.

One of his dreams is to be able to play the fantasy game (in which he is Marvin) called Dungeons and Dragons, on a computer, without having to tolerate the low level of wit which seems to be the best the computer can aim for, by comparison with the human Dungeon Master who designs and manipulates the eerie caverns where Marvin and his friends search for buried treasure.

Naturally, Richard rather thinks viewdata might provide the answer. 'I'd like to have several users all connected to each other, and the dungeon would be created somehow by their wanderings

around, and what they were doing would feed back to each other — I'm sure it could be done.'

Not, however, unless the terminals are a lot more intelligent than the average viewdata TV set. This restriction to the use of Prestel applies to more dignified matters than playing fantasy games — which is why the announcement of a private viewdata system from GEC has been such a disappointment.

A private viewdata system is merely a system of giving everybody a terminal that can get data out of a central computer, with all the disadvantages of Prestel. That is, the terminals are dumb, unable to talk to each other and slow to receive data. Since GEC is the company which supplies the Prestel system to British Telecom, it was widely hoped that there would be rather more signs of awareness inside GEC that times have advanced since it supplied its first 400 series computer to Sam Fedida, inventor of Prestel.

The problem of getting individual Prestel sets to talk to each other remains insoluble. British Telecom says it is possible under a 'closed user group' where all the machines use the Prestel computer as a sort of telephone exchange. This is the only way BT will allow it and it isn't accepting any more closed groups (for finance reasons).

The result is that The Source and Micronet in America, supposedly miles behind our glorious Prestel, offers any micro user hooked up the vastly better service of two information networks (Tymnet and Telenet) with enormous, instantly-updated news and information services, plus the ability to send messages to each other, while micro users in this country have to try getting an expensive PO modem to talk to each other and cannot use it to talk to Prestel.

There is an old saying that guinea pigs never profit from the experiments performed on them, and this applies to the British and Prestel. We are the victims of being first.

And there is another old saying about people who insist you use their service but won't provide it (whether this is modems or closed user groups doesn't matter) for their own reasons; 'dive or get off the springboard'.

BBC programs

Can the BBC possibly put together a TV programme which shows how to program? Can the BBC also launch the book of the program? Can the Beeb also release the machine of the book? Can it publish the language of the machine of the book? And can it sell the whole concept to the American broadcasting stations? And, in view of this month's cover story, is it worth it in the first place? It takes a bit of believing, especially since the current plan is to use the Newbury Newbrain as the machine and to launch the programme in the middle of 1981 (this year).

First, the Newbrain is a nice machine. . . but it isn't available. The first orders are now trickling through but dealers won't promise delivery for machines ordered in November until March. Quite when the situation is expected to improve isn't clear, either, because one of the most reliable signs I know that a machine is in short supply (as opposed to no supply at all) is that the company can spare a couple of dozen for journalists to play with. And if the programme works *at all*, it will be seen by a couple of hundred thousand people, all keen, and of whom I would confidently predict 20,000 as a minimum who would like one to follow the series with. From experience in America, where a series on programming was tried recently, these figures could easily be wildly low, and more like four million viewers will watch, with as many as a third of them wanting a machine before the broadcasts start. I like Newbury but subsidiaries of the National Enterprise Board are notoriously difficult to get moving fast these days and I just don't believe it.



To clean computer products — switches, disks, tapes and so on, you need the right equipment and you also need to know how to use it. Illustrated is an approved solvent for cleaning tape drives; other products are detailed in catalogues from Automation Facilities of Blakes Road, Wargrave, Berks, tel 073 522 3012.

Then there is the problem of getting the language. Apparently the BBC is divided into more than two camps (sic) on how the programme should go — some favour the Newbury as standard, others want a special-purpose machine and both of these camps want their own language — something called ABC, not Basic. I don't know what to say.

All right, I do. You're a bunch of absolute Gonzos, you lot in the Beeb. If you use a standard language you won't stand a chance in hell of getting all the software you need up and running by the time broadcasts start. Oh, yes, running at first, maybe, but just press the wrong key at the wrong moment and watch it crash, leaving half your class with a jammed system, needing a RESET and a complete software reload. If you have a new language on top of this, you won't know where the bugs are because debugging a language is the work of years, not months, and interfacing an operating system to it is another long task.

And here's the daftest thing of all. The BBC has, on every television, a nice little system for loading programs. All that is needed is a Ceefax decoder and some instruction like LOAD Page 287, and the students can start RUNning. So the Beeb isn't doing it. . .

Ups and downs

At the time of writing, it still wasn't clear whether Nascom had gone down the tubes again. From the receiver, the news was clear-cut — there were 'contractual irregularities' and the deal was off. From Peter Matthews there were off-the-record non-comments indicating optimism. Unfortunately these were contradicted by his own remarks to friends, subsequently reported to me, that he didn't rate his chances. And nobody was saying what the problem was.

Nascom is still up for grabs then — though, by the time you read this, it may be all over. Demand for the computers stays high — talk to the dealers who could sell as many as they could get. And there were stocks of parts to build them, say my sources, so really, isn't it about time this farce ended?

PET struggle

Prediction: the Computer Retailers' Association will set up a department specialising in the Commodore PET. If it doesn't, PET dealers will set up a PET Dealers' Association anyway.

According to dealers, the new Commodore terms and conditions don't please them at all. In outline, they cover the time a dealer has to pay for stock he orders, and at what point Commodore ceases to be responsible for them. These are always subjects for dispute between supplier and dealer and the line has to be drawn somewhere — apparently the dealers feel it has moved too close to their side of the desk.

It's hard to avoid the feeling that there isn't much the dealers can do about it. Their idea is to form a strong lobby and to tackle what they see as Commodore's successful 'divide and rule' policy of the past. But unless they are prepared to shift from PET to another machine that sells as well, in the end they are stuck with the deal that Commodore offers.

Whether it affects the end



Shop moves: we proudly show the 16th-century premises in Sheen of the Micro Computer Centre. The address is 28 Sheen Lane, London SW14, the phone number 01-878 7044. You can not only buy computers here — you can hire them.



If you have sometimes wondered why large companies who can afford big computers still go to the bother of buying micros, then this wire may tell you something. It can be up to 200ft long and all it does is connect a video display to a computer. Now, if you have to go to the trouble of laying one of these cables through the corridors to get connected to the central computer and if you think what it must cost (the maker is rather coy about this), you start to see why stand-alone micros look better and better.

customer one way or another remains to be seen. If the Commodore three-month warranty really has to stand up against a year's warranty from Apple dealer (sorry, subsidiary?) Microsense, then dealers will either have to match the Apple terms at their own expense, or put up with some customer drift. With Apple prices floating down all the time, the cost of putting a matching warranty could put the PET into a less competitive position, think some Apple dealers.

We'll see. In the meantime, look for a nice little squabble over whether the Commodore Retailers' Association will or will not be under the control of the Computer Retailers' Association. . .

Shy micro...

Everybody seems to have his or her own theory about why Bruce Everiss, incorrigible boss of Lasky's Microdigital chain of micro stores, has declared that he 'will not put the Acorn Atom in the next catalogue'.

Some cynically claim it is because the margins that Acorn gives dealers are too small for Brucie. It may be and it may not be, but it is worth noting that he manages some very keen prices on the Video Genie, the Oriental imitation of the TRS-80 (now down to £260 plus VAT). And he claims that he is well ahead of the competition by offering a two-year warranty on parts and service for the Sharp MZ-80K, which may be no indication of margins, since the machine is notoriously fault-free. It might cost him nothing to do that and I have no way of knowing.

The reason Bruce himself gives is a little surprising — that he can't get enough machines. Acorn itself is re-assuring on this point — it recently told *PCW* readers that deliveries would be up with demand before Christmas and Chris Curry also reports that production is starting in a Hong Kong sub-contractor, boosting his output somewhat. The figure he quotes is 'around 2000 per month'.

Bruce says this is timid of Acorn (from timid Acorns, what do grow?) and that the company could sell twice that number if it made them. 'I'm a retailer,' he added trenchantly, 'and it's no good having something in the catalogue if I can't send the stuff to people when they order.'

The moral would be: don't order from anybody who doesn't have a machine in the catalogue and complain loudly if you don't get delivery as promised.

Thanks Meyer

Journalists watch each other carefully, but readers tend not to know who writes for which paper, or who thinks what. So although all of us in the Press world know what happened to the first Editor of this magazine, Meyer Solomon, most of you readers can confidently be said to be unaware of his new venture, two magazines called respectively *Computer Age* and *Business Computing*.

Now the point about these papers is that they are competitors of *Personal Computer World*. Meyer Solomon moved on when *PCW* was taken over by its current publishers and might be expected not to hold us all in an overwarm regard.

In the light of that, you will understand that I felt rather humbled recently when a printers' gremlin got into my office and displaced an entire month's supply of press releases from the industry — and Meyer Solomon, hearing of the disaster, stepped forward and volunteered his services, lending me a copy of any press release that I needed.

He took the attitude that, since we all got the same releases, it wasn't fair to allow one paper to struggle through an issue ignorant of the announcements that had been made. This may be true, but it is a generous-minded gesture to act on the principle, and one which many journalists would have dodged.

Peelings...

Price cuts are always welcome in the hardware side of this business so it is probable that it will puzzle some readers if a substantial price cut gets ignored. The price cut on the Microstar, however, is going to get no more mention than this: the old price of £4800 for a single density disk drive version has been cut to £4385, while a double density version comes down from £5600 to £4895.

At these prices, the market isn't going to get worked up about a cut, because it obviously isn't the low, low price that sells the Microstar, even if Data Efficiency says that: 'There is no other small business system with as many operating advantages and performance features at such a low price.'

No, what is interesting is the name Data Efficiency. When Data Efficiency first moved into micros, it bought out the late John Miller Kirkpatrick and used the title of his newly published book *Microsense* as its operating name. Under this name it sold Microstar and Apple.

As I write, Apple in America has finally put its stock onto the exchange and, naturally, not even the managing director of Apple's stockbrokers can get his hands on a share. So much for bluster by various large US corporations that they would 'take over' when the stock appeared.

One thing which Apple said it would do (and later denied having said) when the stock came up on the open market, was set up more overseas operating subsidiaries. One of these, it said, would be Microsense. By the time you read this, an announcement may even have been made, and Microsense may have officially become Apple UK. Certainly, the fact that Microsense no longer handles Microstar is (at least) a pointer. And what difference will it make to users? Maybe not a lot but let's piously put our hands together and say: 'we hope it will be a Good Thing.' It may even be.

CP/M business S/W

If the operating system CP/M from Digital Research is a large field, there are several strong plants growing in it — additions, extensions, developments. One of these, available for some time now, is Graffcom Systems' business operating software ISBS-F which piles a whole series of business programs on top of CP/M, using floppy disks as the main storage medium.

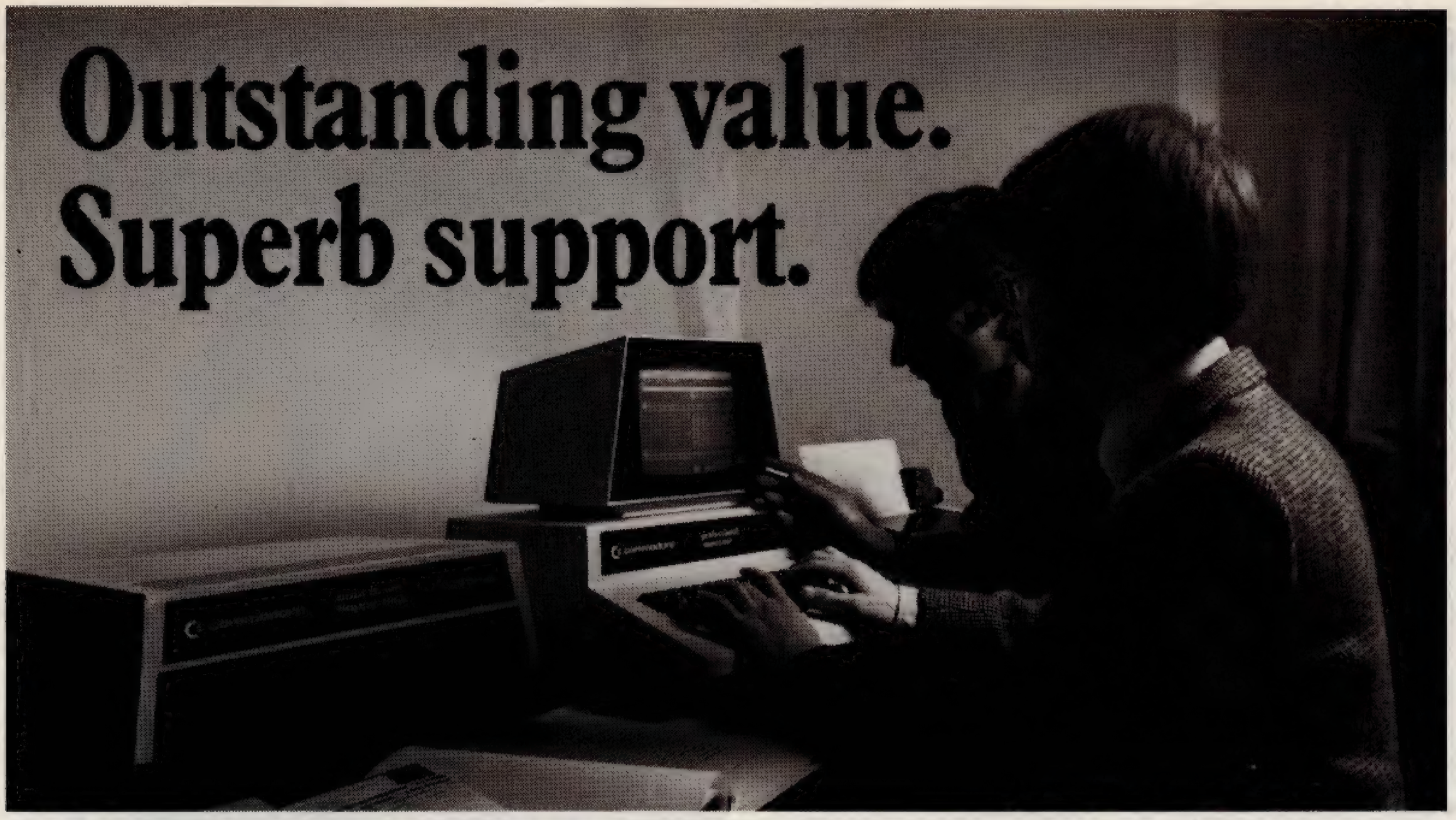
Now this has been improved in its turn. The new package, ISBS-W, is still an 'integrated small business software' but it uses Winchester (big) disks, instead of floppies. That's it. Details on 01-840 3090.

Paper chase

It has been said that Technalogics is a company which could sell a lot more of its viewdata computers if it could make them, which it could if it had the production and finance resources.

One thing the company may not be short of any more is production facilities. Indeed, if the supply of paper available to this Liverpool bunch of whizzkids is anything to go by, their cup runs over like mad — I have six

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01PC1

Press Releases in front of me, each one paragraph long, each on its own sheet of paper, one of these even being upside down.

The source of all this wealth appears to be both orders and support. One sheet of paper reads: 'Technalogics has been given formal backing by the National Enterprise Board; the company manufactures viewdata and Prestel Bulk Update Offline intelligent editing terminals and viewdata adaptors.' Another announcement informs us that the printer will now print out Prestel text and graphics in any size and format. Yet another breaks the news that you can attach a hard disk to the 6800-based computer, making it usable as a multi-user terminal. A mystifying fourth paragraph says that Technalogics has been given a contract to supply hardware, which it won in competition with British Telecom. And before ending up with a list of 'information providers' who use TECS, there is a little paragraph saying that VNU, a Dutch publisher, has awarded a contract for viewdata editing and bulk update systems to Technalogics.

Much more relevant to those of us who want to be information receivers, rather than providers, is Technalogics' list of hardware, the BEE, which can convert any home micro into a Prestel receiver. At the time I spoke to the company, the planned price was a deterrent, likely to be higher than the computer itself in many cases, but by all means contact them in Manchester on 061-793 5293 and ask for details, because the plan must be due for modification.

Sord quest

After the Americans, it is the turn of the Japanese personal computer makers to go to Ireland.

Sord is setting up a £2.9 million factory which will make its range of personal and business machines, mainly for export to European markets. It brings the number of planned Japanese-generated Irish jobs to something like 4000, from nine operating subsidiaries of Japanese companies, says the Irish Development Authority.

Oh Oh Ohio!

Commiseration Corner would be the best title for the OSI/UK user group newsletter. Its readers and contributors are united only in their contempt for the supplier of the hardware and software they are stuck with — not because they don't like what they get for the money but they all wish it worked!

Interesting to see the group's reaction, then, to the announcement of Ohio Scientific's new machine, the C1 Series II.

'We don't exactly think it will improve OSI's market position — quite the opposite. It has all the hallmarks of a badly thrown together bodge — a nasty plastic case, a profusion of little add-on and stick-on boards to fix one thing or another; the serial and parallel ports, colour and sound, while there in principle, are not there in fact, for they aren't actually implemented; the keyboard and garbage collector are as scatterbrained as ever,' writes a reviewer who spotted the machine at the recent Compec exhibition.

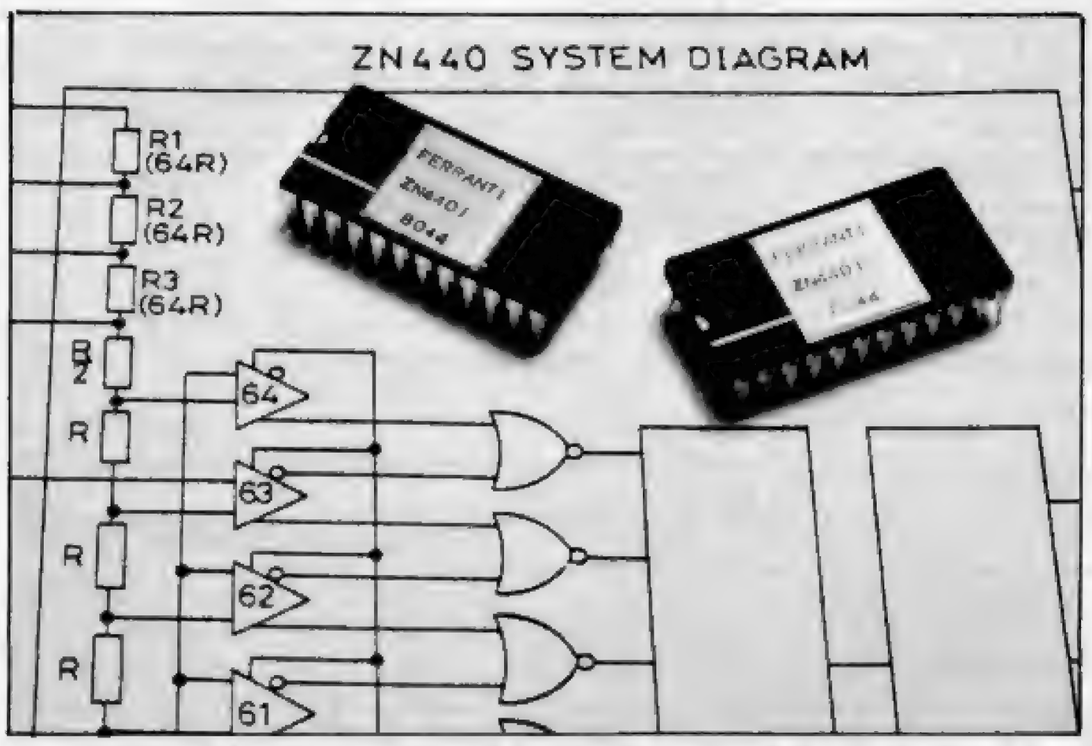
'The colour memory starts at D400H instead of E000H for no apparent reason which makes a 2k screen memory very much more difficult to implement and the much-vaunted 12 x 48 screen format can only run with a software patch, which in any case overwrites the few locations that its still absurdly limited machine-code monitor uses. Documentation is marginally improved but still diabolical — most of it was for the disk system which wasn't even at the show.'

You would never guess how much these characters enjoy playing with their systems from this sort of thing, would you? Oh, yes, they do, because they actually recommend that you rush out and buy the old Superboard now, before the new £100-extra version replaces it.

Would-be members contact Tom Graves, 19a West End, Street, Somerset BA16 0LQ. He's setting up a ComputerTown UK site down there, by the way.



Long ago, some computer expert decided to glue several copies of the same form together, so that the top copy and the bottom copies all had the words in the right boxes. Then he fed it into a computer printer, bottom first, and, as they all went round the roller, they all came unstuck. That's why Mannesman Tally has adjusted this printer to print upside-down. The result, say engineers, is perfect printing when the form goes in upside-down too. Details on 0734 580141.



Normally chips to turn analogue vibrations into digital pulses with values work slowly. This new six-bit A/D chip from Ferranti will run up to 18 mega-samples per second. Details on 061-442 6060.

Peripherals processed

There are many customers of microsystems to whom price is not everything. Some of these can be dismissed as merely ignorant — others have priorities above mere cost. It is easy to look at the Transdata range of Cx500 microsystems and say that for £3500, a system with two 8in floppy disks is overpriced — but there are obvious compensations, because many of the customers of the range do know what they want. And one of these customers is British Telecom.

The point that impresses on the Cx500 is not the one that the company makes most song and dance about (the fact that it is a 'multi-processor'). It is the fact that the company is very expert on what it calls 'communications systems'.

To a large extent, communications on the Cx500 are good because of the multiprocessor basis. In their own technical phrasing, 'This multiprocessor structure permits additional processing modules to be added, which are dedicated to managing particular tasks, or controlling specific peripheral devices.'

The basic Cx500 uses a Z80 micro with CP/M as the disk operating system — a combination so common as to be self-recommending, because it allows software from other machines to be transferred. Which means you don't have to write it from scratch.

Transdata uses a system of plugging in extra processors whenever a new process is needed, as mentioned above; one of the most important things about the way this is done is the fact that the extra processors are plugged directly into the system bus — that is, they control the main computer's memory as if it were their own.

Where this scores is when you want to add a new peripheral — you want to read data from a disk instead of a tape, or you want to drive a different printer — without telling the operating system that you have changed. A peripheral processor (programmed by Transdata) can

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AGENTS THROUGHOUT THE UK AND OVERSEAS



NEWS

ComputerTown UK! is a nationwide network of voluntary literacy centres.

Twenty one! That's the number of districts that are now seriously interested in ComputerTown. Not bad in the six weeks since the first announcement is it? Of the 21, two are already in operation — Eastcote and Sutton-in-Ashfield. Eastcote, being a very small library, could only cope with two machines on the first night. Both were PETs — one on loan from Supersoft, the other brought along by one of the helpers. Incidentally, our thanks to Cream Computer Shop for fixing a nasty little hardware bug just before the big day. Eastcote was kept pleasantly busy all evening, purely on the strength of a poster in the library plus a bit of 'passing trade'. No doubt, next time, word of mouth will be responsible for a significant increase in traffic — we'll see.

Sutton's second ComputerTown evening was an altogether calmer affair than its first night when around 100 people turned up. The second evening kept three machines (two Atoms and a 6800) nicely busy. The librarian is probably breathing an immense sigh of relief — see last month's letter from him. The Atom, which Sutton have permanently glued to a library table, has been kept busy almost continuously, so for those with the space (and the money) this seems like a good way of spreading the word during your absence.

Space is tight so let's swiftly move on to the many letters received this month. Edward Teague, who is working on a ComputerTown Romiley, writes to tell us we should have included the Sharp MZ-80K in the list of machines suggested as being good for ComputerTown. True, true. Vernon Gifford of the ACC and Croydon Computer Club is planning a ComputerTown Croydon — all interested write to him at 111 Selhurst Road, London, SE25 6LH, preferably enclosing a first class SAE. John Nicholson writes from Old Forge Workshops, Sparrows Green, Wadhurst, Sussex TN5 6SL — he'd love to meet any other ComputerTown enthusiasts in his neck of the woods (Tunbridge Wells). John has a fairly grown-up Vector MZ which he's using to voice pipe organs in his workshop. He can be contacted on 089288 3715. Mal Part writes from Witham in Essex to wish ComputerTown all the best and to offer his services together with his PET. Anyone in Mal's locality who'd like to join in should contact him on 0376 511806 after 7pm weekdays, or anytime weekends. Alternatively write to him at 35 Town End Field, Witham, Essex CM8 1EU.

Up now to Scotland, whence John Wilson writes on behalf of the Scottish Amateur Computer Society (SACS) who are already heavily into computer literacy. They plan to run courses for adults and children — slightly more formal than ComputerTown but, no doubt, just as friendly. Anyone interested should contact John at 21 Rowantree Grove, Currie, Midlothian (that's near Edinburgh).

Julian Allason writes from his secret Berkshire hideout to offer all the help he can. He got off to a flying start by persuading his friends at Commodore and Petsoft to donate a few programs to ComputerTown, Eastcote — thanks Julian and thanks Commodore and Petsoft. As a result of this favouritism we realised that we ought to find out what the score is for all those other ComputerTowns. Commodore told us that it has some 200 programs in the public domain — ie anyone can copy them — so we'll bring you more news of that next month. In the meantime, raid your own tape libraries and try and scrounge from your local dealers. All donations will be publicised through our monthly ComputerTown News page. Julian will also be promoting the project through the pages of his illustrious organ, *Printout*.

A 'name and address given' letter from Newcastle upon Tyne bodes well for a group up there. Unfortunately we can't say any more than that at the moment because the person concerned must clear the idea with his peers before making a commitment. Anyone in that area interested should write c/o ComputerTown, 14 Rathbone Place, London W1P 1DE. Gwent Computer club are taking CT seriously — they can be contacted at 10 Park Square, Newport, Gwent.

Roger Farrell of Sydney, Australia dropped by to pick up some ComputerTown bumf. He went off highly enthused, so we can maybe expect to hear from ComputerTown, Collaroy, Sydney, Australia. (9 Hendy Avenue, if anyone wants to contact him).

Andrew Hinchley is setting up some kind of computer literacy project in Hackney which may even become a ComputerTown. Anyone interested contact Andrew on 01-405 8400. Peter Faff, of 'Printerfacing' fame, would like to help out in his home town of Hitchin in Hertfordshire. Anyone else in the area might like to contact him at 22 Common Road, Stotfold, Hitchin, Herts, SG5 4BX. Telephone 0462 732432.

Meyer Solomon wrote us a nice letter. He will be including something on the project in his magazine, *Computer Age*.

Wimbledon CT is being set up by Tandy's David Payne, Anyone in that area should contact David at 87 Kirkstall Road, Streatham Hill, London SW2. Writing will be best since he's hardly ever there.

Martin Kennelly writes again from Derby to say that the pace is hotting up there. He's brought his own TRS-80 and is now working on somewhere to hold his CT evenings. Anyone interested should contact Martin on 0332 550408 or write to 18 Welwyn Avenue, Allestree, Derby DE3 2JQ.

A visit to Ccmmodore resulted in their offering to publicise ComputerTown through their trade and education newsletters. It also resulted in some very nice PET posters showing what all the bits are and listing its various capabilities. Sounds boring but looks lovely.

Peter Lambert of the National Computing Centre (NCC) is going to talk to David Fairbarn, NCC's director, about ComputerTown. We look forward to hearing from him again. Michael Lyne writes from Lincoln to say that the Lincolnshire Microprocessor Society will be discussing the project. Let's hope this leads to a ComputerTown, Lincoln. Anyone interested should contact Michael at Far End, Far Lane, Coleby, Lincoln LN5 0AH or telephone Lincoln 810468. P D Street, who runs a boys' club and has access to a TRS-80, is interested in getting a ComputerTown going in Atworth, Melksham, Wiltshire. Anyone in the area can contact him at 49A Bath Road. Ilminster (see the cover story) may soon be boasting its own ComputerTown. David James is very keen on the idea. He can be contacted on 04605 3011. Gareth Williams writes from North Tidworth, Hants. He is well qualified to run a ComputerTown but the only problem is that he hasn't got a machine! Anyone else in his area should contact him at 36 Cherry Tree Avenue, North Tidworth, Hants.

Finally, we had a visit from Tom Graves, who is setting up a ComputerTown in Street, Somerset. He tells us that the only night he can run his project is the night the fish and chip shop across the road is closed. He just dreads the thought of all those greasy fingers on his keyboards!

Well, thanks to all of you — it really looks as if ComputerTown is going to work. Remember, we need centres all over the country so if you're more than a few miles from your nearest centre why not set up one of your own? Further information can be obtained from ComputerTown, c/o 14 Rathbone Place, London W1P 1DE — remember to include an SAE for a reply. Please *don't phone us* as this is a spare-time project. Finally, please write and tell us your news. There are too many people setting up projects for us to be able to contact them regularly so the communication must be from the centres to us and then out again via *PCW*.

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All this, and much more can be yours if you take advantage of Meridian Tours' special offer to PCW readers, details of which are now being finalised.

Three holidays are planned, each of which ensures that you are in San Francisco for the duration of the Faire, which must be the biggest micro-dedicated show in the world. The first holiday comprises one night in Los Angeles at the first-class Sheraton Miramar at Santa Monica Beach followed by six nights in San Francisco at the Civic Centre Holiday Inn, just round the corner from the Faire. The second holiday provides the chance to spend three nights in Los Angeles and four in San Francisco while the third allows you to 'do your own thing' for a week following one of the above holidays, simply returning to base for the journey home.

The holiday price includes all flights, hotel accommodation, supervised transfers between airports and hotels, entrance to the Faire, a copy of the conference proceedings and compulsory insurance. The cost does not include transport to and from Gatwick, meals abroad or additional accommodation for those wishing to stay an extra week.

Car hire can be arranged at special rates by Meridian before departure and special excursions may be booked with their local representatives while abroad.

Having said all that, this promises to become quite an event in the PCW year; it's bound to be fun — even for those who aren't too interested in computers. They can make the most of San Francisco with its Golden Gate Bridge, cable cars, Chinatown, Fisherman's Wharf — not to mention a more recent phenomenon, lobby watching in the Hyatt Regency.

For further information and a booking form write to West Coast Trip, PCW, 14 Rathbone Place, London W1P 1DE.

This holiday is being organised by Meridian Tours Midlands Ltd who are bonded tour operators
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YANKEE DOODLES

Tom Williams in California reports the latest news and rumours from Silicon Valley.

Connoisseurs of Adventure games will be delighted at the new delicacy being served up by Personal Software: Zork has come to microcomputers. Zork is a product of MIT's Computer Science Lab and was originally written by David Lebling, Marc Blank, and Bruce Daniels for a DEC PDP-10. The fact that even a significant subset of Zork has been made available for 32k Apple IIs and TRS-80s is a tribute to programming skill, because Zork is one of the richest computer fantasy games.

The command structure of Zork consists of 'actions' and up to two 'objects'. Thus, ATTACK TROLL WITH MACE would be a typical command. The feature of Zork that sets it apart from similar computer fantasy games, like the classic Adventure, is the richness of its text and the variety of interesting possibilities it presents to the player. The interesting thing about Adventure-type games is that once you've figured out one (no mean task if the game is any good) the variety offered by another is irresistible — this from a confirmed Adventure addict.

Rumours

At the high end of the trade (for those thinking about trading in their Rolls-Royces) there are rumours coming out of Hewlett-Packard's Colorado stronghold that the company is working on a desktop computer that will run a high-level processor chip similar in concept to the type being developed by Intel. Sources say that benchmark tests on the 32-bit machine have turned out faster than an IBM 370/158. Now the limiting factor on computer power for a desk-top machine appears to be the amount of power that can be drawn from a common wall outlet without requiring special wiring. That may sound far-fetched in a remote laboratory today but we all know where these things lead.

Great things are happening in graphics: more resolution, better speed and lower cost. One of the more interesting gadgets is an adaptation of what was once a very sophisticated S100 graphics system to a *very* sophisticated graphics and imaging peripheral. Digital Graphic Systems of Palo Alto, California, has combined its CAT-100 system with a Z80 processor and firmware and a parallel interface to create a peripheral that will not only display high resolution graphics (in the top model, up to 512 x 256 x 8 pixels in any of 16 million hues) but will also instantly digitise a TV frame with the use of the 'frame grabber' feature. The picture data can then be manipulated, animation created and output to a display or to a video recorder. Bob Flexer, inventor of the CAT-100, has pulled picture data from the Voyager Jupiter mission directly from a TV set and stored it on disk to demonstrate the system. The new peripheral is available for most computers with parallel I/O and the firmware graphics commands can be called by the host. DGS is planning to introduce a separate disk controller option, so image data can be instantly stored without going over the host interface.

'What has been happening with Heathkit?' The answer, it turns out, is 'Quite a lot.' Since the leader in electronic kits was purchased by Zenith, the consumer electronics giant, there have been developments in the computer line that are definitely aimed at the small business market. The star of that development has been the Z-80 based H-89 stand alone computer. The H-8, the machine that got Heath started in the computer business, seemed all but forgotten.

The hobbyist market, although tiny compared to the business world, is nonetheless very real and has been largely abandoned. Heath has apparently recognised an opportunity to serve its traditional clientele via the H-8. One avenue has been to introduce a number of interesting board-level products, and the other is to make available source listing of system software. . . something that is a closely-guarded secret in other companies.

Getting back to the earlier remark about graphics, Heath has introduced a new graphics board which uses the Texas Instruments 9918 video display processor, which has a basic resolution of 192 x 256 pixels. The 9918 also works with an overlay technique that can store four independent sets of images that can be alternated instantaneously. Patterns up to 16 pixels square can be defined and stored, and 16 colours are available.

Portability

THE UCSD Pascal system is becoming the software choice for a growing number of corporations who are waking up to find that microcomputers have invaded their operations almost without the awareness of upper management. They are now such an important part of day-to-day work that they are definitely here to stay. The problem management now has is to try to get some economy out of a de facto situation.

The main problems are involved with portability of software — the need to transfer programs between often quite incompatible machines. The UCSD System (so called because it now supports Fortran in addition to Pascal) is the only software system for micros so far which addresses the problem by creating an in-between code, pseudocode, which is independent of any processor's instruction set. Pseudocode can thus be interpreted and run by any machine to which the pseudocode has been adapted.

In large organisations, some order is at last being achieved in transporting programs among individual machines, many of which were initially purchased by the employees themselves as an aid to doing their jobs. Now, the micros have become entrenched and an ever-increasing number of department heads are seeing the wisdom of providing their people with the proper tools.

The next step will be local networking or the use of clustered systems. At present, this is only being done with compatible machines, as with the Apples used with Nestar's Cluster/One or the 8086-based machines used in the new clustered system introduced by Convergent Technologies of Santa Clara, California. The Convergent system is still a step farther along the road. It communicates with its own machines over a high-speed proprietary bus and communicates with a Shared Resources Processor (SRP) that handles disk access and peripheral usage for the various workstations. In addition, there is also a Multibus card cage to allow customisation of the system by plugging in any of a huge variety of Multibus circuit boards now available. Convergent Technologies is developing a Multibus-based card that will allow the system, in addition to communicating over its own bus, to access the Ethernet system being jointly-developed by Intel, DEC, and Xerox.

So much for the automated office. If anyone has any doubts that the totally automated factory will soon be a reality, then they need only look into Hewlett-Packard. HP is actively developing a line of small computers with wide I/O bandwidths and real-time interrupt-driven operating systems with the express intention of making possible computer control of individual machines on the factory floor. But beyond that, HP sees the need for these machines to provide data to higher level computers which can then provide it for data bases used by management. The 'management' computer will have to be able to analyse the data provided, download the appropriate programs to the 'worker' computers, and the whole network will have to be controlled by 'switchboard operator' computers, or I/O intensive, real-time network controllers.

Such a system is possible today, although software, financing and overcoming entrenched ideas are still problems. But there is every reason to believe that forward-looking American companies will make the move towards more total automation as the economic situation worsens and the threat from Japan increases.

Leaders in the electronics industry have already recognised the fact that automation increases the productivity and, interestingly enough, the *quality* of the manufacturing process. Thus, the economic rationale for such moves already exists. What will follow will be to a great extent a social problem as we witness for the first time in history an increase of both real wealth and of unemployment. Should be interesting — think I'll hang around to watch.

COMMUNICATIONS

PCW welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add "not for publication" if your letter is to be kept private. Please note that we are unable to give advice about the purchase of computers or other hardware/software — these questions must be addressed to Sheridan Williams (see 'Computer Answers' page). Address letters to: **'Communications', Personal Computer World, 14 Rathbone Place, London W1P 1DE.**

Commodore complains

I appreciate that journalism is sometimes about 'creating' stories and that, as the leading UK microcomputer company, Commodore is often fair game for a dig! However, the November issue of *PCW* was factually incorrect both about Commodore and myself in two areas.

The first incorrect statement was in an article by Guy Kewney which stated he did not believe the official announcement by Commodore and myself about the 8050. Guy stated 'that at the time of writing 90 days plus ten have elapsed since the last time I spoke to Kit.' He went on to say 'I have to report no evidence of the promised 90 day delivery on the 8050.' My statement was made when we announced the 8050 at the PET Show (June 13/14) and that we anticipated commencing delivery in 90 days. My records show that we did start delivery in the third week of September which was 90 days from the PET Show and nearly 60 days before I received my copy of *PCW* stating that there was no evidence of deliveries! We had been delivering continuously during the period since September.

The second incorrect statement was on the 'Computer Answers' page where Mike Dennis stated Commodore is also unhappy about other manufacturers supplying add-ons such as the Computhink disk drive and is trying to make this sort of thing as difficult as possible. The reverse is true. We have an official scheme for encouraging reputable software houses and other companies who develop add-on products for the PET. Indeed all enquiries we receive from the public are sent a catalogue of Commodore 'Approved Products'. These products are not manufactured by ourselves. This naturally does not mean we will approve everything as we are trying to establish meaningful standards.

With many approved product companies we are working closely and in some cases have released pre-production equipment for development work to ensure maximum support to users as possible. You will probably have noted that coincidentally with the release of our 8050 drive we were able to release some excellent software products.

Whilst I appreciate that the microcomputer world is still a young and growing industry, it does seem to be full of sometimes unfounded remarks and gossip. During the three years since launching the PET microcomputer we have made some mistakes as happens in any new business area. However I believe we have always managed to offer excellent value for money, continually tried to improve standards and have the best supported microcomputer in the market place. If this was not true it is unlikely the public would have continued to support our products and PET would not have been such a success. Is it not time we stopped looking backwards to the first few months of the microcomputer industry. We should view the situation as it stands today and try to set standards we would like to see for tomorrow. I believe this should apply to journalism as well as in manufacturing.

I wish your usually excellent magazine every continued success in the future. I also hope you will be a little more careful in checking your facts before condemning people — with the authority of a leading magazine such as yours should go responsibility.

I would be grateful if you would point these facts out to your readers.
Kit Spencer, Commodore, Slough

What you say is true, Kit. We perhaps make the mistake of looking at the world from the reader's point of view. We understand that although disk drive deliveries were started in September, these were for demonstrations only. Deliveries to actual users didn't start until some weeks later. We take your point about add-ons — you do indeed support some.

Our advice to PCW *readers is to talk to local suppliers about true delivery situations. Commodore clearly cannot make guarantees about end-user deliveries when they are only responsible for deliveries to dealers — Ed.*

Pools polish

Following publication of my article on football pools forecasting I have done some further work myself and have had discussions with one or two colleagues. The result is that there are a few additional or modified lines which will make the program more effective and, indeed, correct a theoretical error in one of the calculations. These are listed below.

Further to this, I suggested in the article possible ways in which the program may be squeezed into an 8k machine. It seems in the event that my suggestions were inadequate. For this I apologise to any of your readers who have spent time trying to squeeze this particular quart into their own pint pot. My only other suggestion, which I have not tried, is that the program be made into three separate ones, one to create and file the initial leagues, another to update the leagues with new results, and a third which simply reads the leagues from files and makes the forecast. Whether this approach would handle all leagues or one at a time I leave to the programming ingenuity of your readers.
A L Green, Norwich

Benchtest update

My colleagues and I were pleased with the very fair review of our Microengine-based machine, the Raannd SP1, in the December issue. I am also pleased to announce the changes to the pre-production prototype employed in the review to produce the current production model.

The production version of the Raannd SP1 has the following additional features: full numeric keypad, full cursor pad plus 8 special function keys, fully-screened monitor thereby erasing the line interference with the display, an etched screen, thereby obviating the filter, in white P4 or green P31 phosphors. In addition, later revisions of the software, with Vers IV Pascal (full concurrency) software in February or March.
Dr. Gordon Rankine, Raannd Systems Ltd, Livingston Scotland

Pascal benchmarks

Thank you for sending the correspondence received concerning our 'Pascal Benchmarking' article. Before you send any more, please publish this! We have discovered (and so have your readers) that one of the programs appears to have been wrongly transcribed. This is PROGRAM MATHS which should read:

```
program maths;
var k:integer;
    x,y:real;
begin
    writeln('s');
    for k:= to 1000 do
    begin
        x:sin(k);
        y:=exp(x)
    end;
    writeln('e')
end.
```

Most of your correspondents felt (rightly) that exp(10000) was a bit heavy going for a micro.

We would like to respond to all the points raised and tabulate all the results given

```
117 DIMQA(130),QH(130)
10010 IFEN=1THENRETURN
11291 TX=TH(HT):TH(HT)=XT*(Q1-QH(HT))+(XS*TX):QH(HT)=Q1
11296 TX=TA(AT):TA(AT)=XT*(Q2-QA(AT))+(XS*TX):QA(AT)=Q2
11660 X1=PP(J):X2=HR(J):X3=HG(J):X4=AR(J):X5=AG(J):
      X6=FH(J):X7=FA(J):X8=TH(J)
11670 X9=TA(J):X1$=N$(J):Y1=QH(J):Y2=(QA(J)
11740 TH(J)=TH(J+1):TH(J+1)=X8
11745 TA(J)=TA(J+1):TA(J+1)=X9
11746 QH(J)=QH(J+1):QH(J+1)=Y1
11747 QA(J)=QA(J+1):QA(J+1)=Y2
13111 PRINT#1,QH(I)
13112 PRINT#1,QA(I)
14010 IFEN=1THENRETURN
14111 INPUT#1,QH(I)
14112 INPUT#1,QA(I)
```

Mods to the pools program — see 'Pools polish'

in a future article but in the meantime may we thank *PCW*'s readers for all their timings.
Chris Sadler, London

Atari query

Having read the Bench-test of the Atari 400 and 800 computers, I am considering buying one of them. I would like to have details of these machines, how much they cost and when they will be sold in the UK, but I have been unable to find an address to write to.
R Shenton, Stratford-Upon-Avon

Write to Ingersoll Electronics, 202 New North Road, London N1 7BL — Ed.

ZX80 memory

Further to your correspondence about memory left in the Sinclair ZX80 during programming, I'm afraid that the latest suggestion — to PEEK 16400, etc — is not much better than the earlier suggestion. The problem is that this doesn't take into account the number of bytes which will be used by the display as soon as the program is run, since the display file contains nothing but 25 end of line codes, unless and until there is something actually on the screen. Obviously, the usable memory left is governed by what is eventually to be needed for display purposes once the program is completed and run. Thus, one can only estimate according to the likely extent of screen usage at its maximum extent during the RUN. Also, it is not quite true to say that 17408 is 'near enough' the top, since it is very likely that 40 bytes will be used for the stack. 17375 would be a better estimate. While it doesn't particularly matter which of the system variables are PEEKed, between 16392 and 16400, I would point out that they all, in themselves, use quite a few precious bytes, at least if incorporated into the program.

I offer a discovery I happened to make recently.

If one keys in:
1 PRINT USR (47)
this will show the address of the end of the Variables.
A figure, if desired, of the count of bytes, can then be obtained if the above is amended to:
1 PRINT 17375 — USR (47)
From this, of course, must be subtracted an estimate of the number of bytes required eventually for display.
Michael Kirkland, Prescot, Merseyside.

Stamp scheme

In answer to your reader Neil Stokes' query about computing philatelists — I am one such! I use an Apple II with disk drive (courtesy of the school in which I work) to store want lists of stamps needed, in files, by country. These I then update and send to my correspondents around the world.

I am also working, in the planning stage, on a catalogue program to update the value of my collections and to diagnose the areas showing the greatest appreciation, etc. I would be very grateful to hear of anybody else working in similar, or other, philatelic fields.

Any listings on paper or, if Applesoft, on diskette please.
John Oldfield, Calle Galatxo 29, Capdella, Mallorca, Spain.

Apple omissions

I wonder if you would make it clear to your readers that Apple computers offered by this company are in fact genuine Apple II Plus machines covered by the standard 90 day warranty. The omission of the Apple Logo in December's *PCW* was a production error.

Allen Timpany, Guestel Ltd., Bath.

Glad to set the record straight Mr Timpany — Ed.

Sharp words

I am writing to you about a recent letter in *PCW* concerning the LIMIT MAX command on the Sharp MZ-80K.

The solution you suggested although it works, cannot be used in a program as the LIMIT command may be used. Since only the LIMIT MAX is affected, it is possible to use the ordinary LIMIT followed by an address:

Machine size	Command
20k	LIMIT 24576
24k	LIMIT 28672
36k	LIMIT 40960
48k	LIMIT 53248

In each case the address is one more than the highest memory location. You said that some MZ-80Ks produce this problem but in fact it is common to all machines running SP5025 Basic if the command is used after the clock has been accessed in Basic. This is because Sharp has left only eight bytes for the time storage and a carriage return overwrites the location where the upper RAM address is stored.

With reference to the letter about AND and OR on the Sharp, it should be noted that a combination of both AND and OR cannot be directly replaced with * and plus. Statements like X = (5 AND 7) are also not easily simulated.
Duncan Booth, Aberdeen

ZX80 fix

Your readers might be interested in:

The solution to your problems with LOADing and SAVEing programs from/to a cassette tape recorder using the Sinclair ZX80.

I recently bought a ZX80, and had great difficulty with the cassette interface. I know that I am not alone experiencing that. The solution is:

1. Use a small pre-amplifier between the ZX80 and the cassette tape recorder. (see later). You use this, when SAVE ing.
2. Use only best quality cassette tape. (I recommend Afga Super Ferro Dynamic Low Noise.)

About the pre-amplifier: this is a small battery-operated two-transistor version, which I bought in kit form for around £3 at the local electronic kit-shop. (At: Josti Electronic, Vangedevej 116, DK2820 Gentofte, Denmark.) The name of the kit was: Line-amplifier AF45.

The kit named above makes all the difference between unreliable and reliable use of the cassette interface with the ZX80.
PS: Thanks for a really good magazine.
Hasse Taube, Copenhagen, Denmark.

Ohio challenge

In your 'Computer Answers' of November 1980, I think P McIlmoyle, replying to D N Hardwick of Stourbridge, should have mentioned OSI equipment.

By comparison with the £500 quoted for the PET, and £420 for the Tandy, £350 spend on an Ohio machine could provide 8k of memory, colour, 50 percent extra screen display with the potential for just as much expansion, and if initial econamy was most important, a completely functional machine can be bought for less than £200 still with the expansion potential.
Roger Beaumonth, Keighley, Yorks

PET POKEs

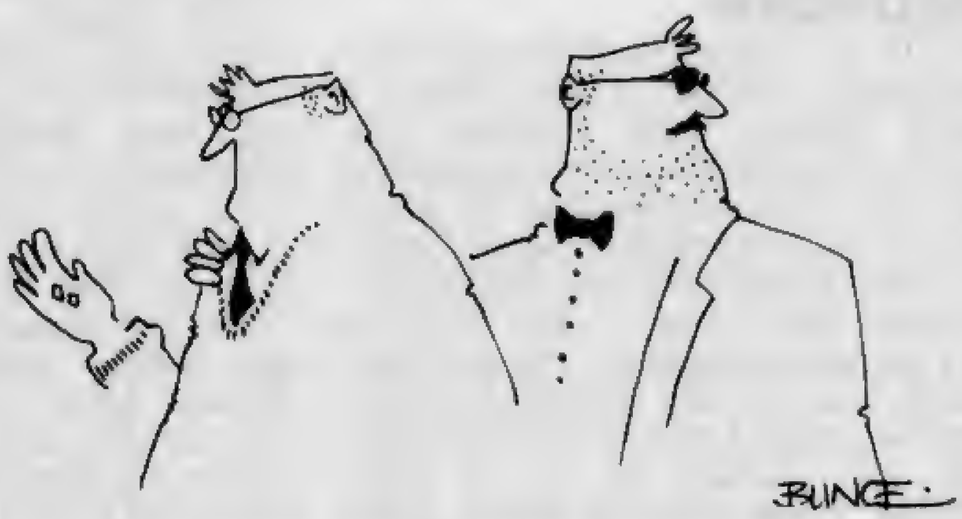
Many of your readers will be acquainted with the Commodore PET 'Space Invaders' program and many of them are probably left-handed. I myself am one of these unfortunates; I too wish that the controls of the program were the same way round as the real thing.

I have dissassembled the program and can reveal that the appropriate modifications are as follows:
POKE 1428,252
POKE 1430,253
POKE 1442,254
POKE 1938,8
POKE 5434,65
POKE 5462,68
POKE 5491,74
POKE 5945,253
POKE 5953,254
POKE 5964,247

These modifications only apply to the NEW ROM version of the program, though I suspect that they may work on the OLD ROM program as well. The new controls can be read in the instructions; they are A-Left, D-Right and J-Fire.

Anyone who knows how to record the corrected version onto a tape (for the sake of Commodore's profits I won't relate the method, but it is in the PET manual) might just as well correct the spelling mistake on the first screen by POKE 7736,15.

To make the changes, load the program using the LOAD command, type the POKE instructions and then type RUN. The whole program will then function as per normal, only the commands have been changed.
William Roberts, AC Systems, Exeter.



'Just a minute! How do I know there's 47 blue movies in each chip?'

BENCH TEST

VECTOR GRAPHIC VIP



Stephen Withers examines Vector Graphic's new micro.

In the past, Vector Graphic microcomputers have been built around the 'mainframe' concept — a box containing an 18-slot motherboard, power supply and disk drives to which a terminal and other peripherals may be attached. The VIP is a departure from this tradition, as it is a computer within a VDU, an arrangement which is becoming increasingly popular.

Hardware

The VIP is a mixture of old and new components, housed in the Vector 3 console chassis. This 'Mindless' terminal has been given a power supply and a six slot S100 motherboard of which four slots are occupied. A fan is provided to keep things cool and, fortunately, it makes little noise — less than an idling golfball typewriter. The processor board is Vector's new ZCB single board computer, a Z80A with 1k of scratchpad RAM, and sockets for up to three EPROMs. These may be either 2708s or 2716s, selectable by jumpers. External input/output is handled by an 8251 IC driving an RS232 serial channel (this may be converted to 20 mA current loop) and an 8255 which offers either three 8-bit parallel I/O ports, or two with handshaking lines. This means that most printers may be connected to the VIP, including those with a 'Centronics' style interface, although these will require some extra connectors and cabling within the VIP, as only the serial port is connected to a socket on the rear panel. Provision is made for three additional DB25 connectors.

The display has a non-reflective screen and is driven by the Flashwriter II board, which is impressively fast. This has been reviewed by Andrew M Stephenson in *PCW* (February 1980) so I will not go into any detail. Suffice it to say that it provides a very steady 80 x 24 line display, with upper and lower case alphanumerics, inverse video and limited graphics symbols. User-defined character sets may be installed. The contrast may be adjusted by a control on the rear panel, which also carries the on-off switch and a very small reset button.

A good keyboard is fitted to the machine. Although it was a fraction light for my taste, I soon got used to it. In addition to the conventionally laid out main keyboard, there is a numeric pad and a cursor control cluster with all keys auto-repeating if held down. I was pleased to see indicator lights on the shift lock and caps lock keys.

The VIP is fitted with 64k of 4116 dynamic RAM chips on one board, although the top 8k is disabled to make room for the video and scratchpad RAM, and the 'Extended Systems Monitor', printer driver, and bootstrap PROMs. The second highest 8k may also be disabled independently of the top section. This seems a funny way of going on, even though it is cheaper than using a 58k plus an 8k board. However, I am not convinced that a 56k board would not be cheaper and it would also be useful in other systems, such as the North Star Horizon. As bank selection is supported, up to 192k (three banks of 64k) may be present in an expanded system. (Theoretically, eight banks could be used, but there are only two spare slots on the motherboard.)

The disk subsystem is another tried

and tested unit. The controller board itself is made under licence from Micropolis and takes care of a single 5¼in, 77 track, 315k Micropolis drive housed in a separate cabinet. This cabinet contains its own power supply, fed from a socket on the rear panel of the VIP. The cable between the controller and the disk drive is clamped to the cases to prevent accidental disconnection, although this does mean that the case must be opened to disconnect the drive prior to moving the system. The main failing in this area is that, while the read/write head lifts four seconds after an operation, the disk continues to rotate. It is only possible to stop it by dismounting the disk, a practice strongly encouraged by the manual. As this is essential for long disk life, why doesn't the controller turn the drive off?

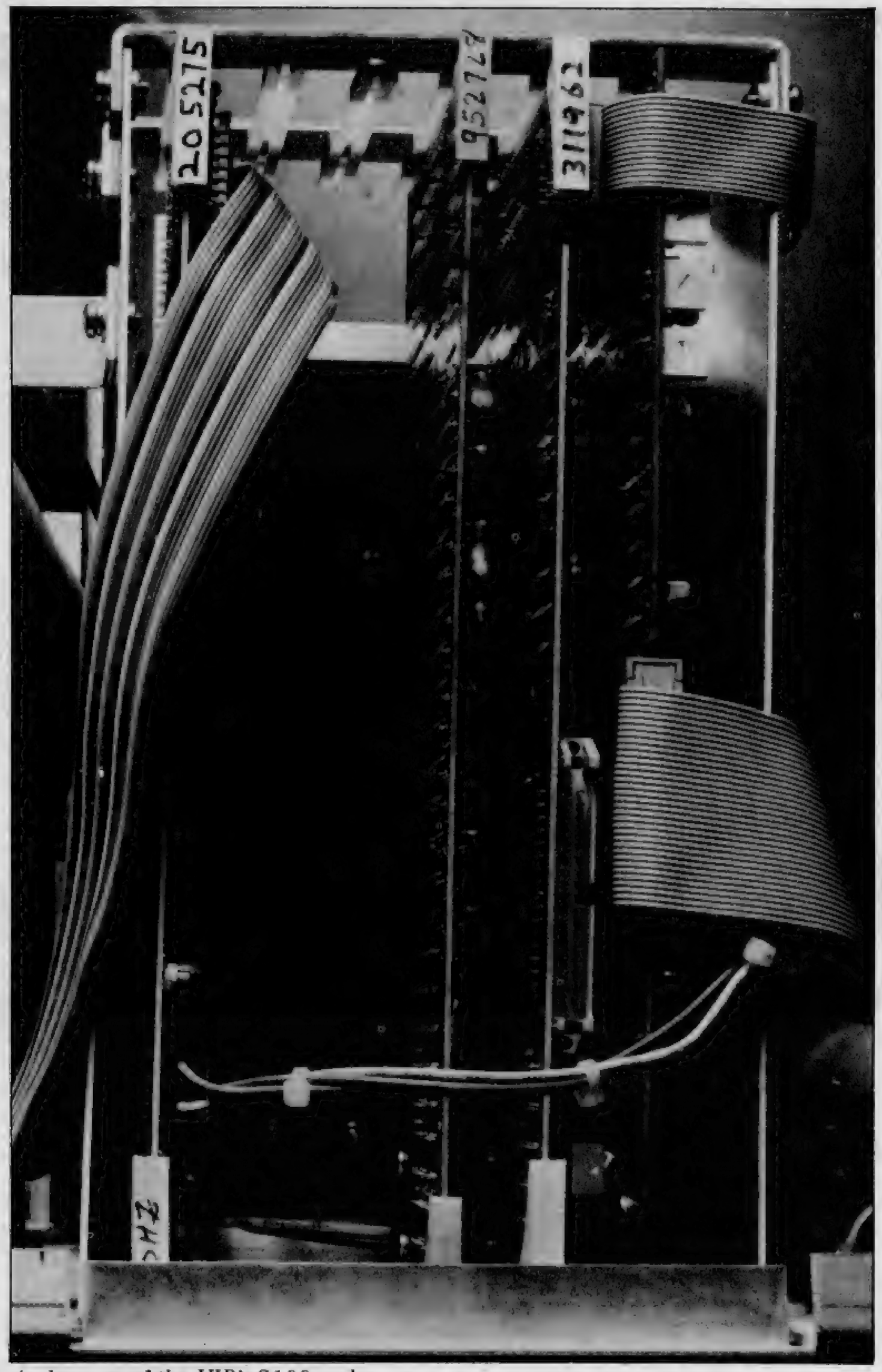
Software

The Extended Systems Monitor is entered whenever the machine is switched on or reset. Depressing the 'B' key boots CP/M 2.2 from the disk drive. In addition to all the usual CP/M utilities, a number of programs are supplied by Vector. Perhaps the most useful is SCOPE, a screen-oriented editor which is a vast improvement over ED, although it is dependent on the Flashwriter. It allows the creation and editing of files with line lengths of up to 250 characters with pan-scrolling. The row and column number of the cursor's position is displayed at the top of the screen so you know where you are at all times. If you have never used a screen-oriented editor, you don't know what you are missing! The ability to see the results of the changes instantly makes editing a much easier task.

A Z80 assembler (ZSM) is provided which, however, doesn't use the standard Zilog mnemonics — 'extended' 8080 codes are used instead. What you think of this will largely depend on which instruction set you are used to. If you are happy with the 8080 you will be okay until you want to assemble someone else's Z80 source code (a booklet is provided with the ZSM equivalents to ease the problem) and you will be able to ignore the CP/M assembler. On the other hand, if you speak Zilog, you will probably end up paying for a 'proper' assembler from another supplier.

This problem with mnemonics extends to the other major addition. This is RAID, an acronym for RApid Interactive Debugger. This may be used in two modes, either as a conventional debugger, or as a simulated processor. When the CPU is being simulated, the upper 18 lines of the display show exactly what is happening: the registers, the instructions most recently executed and those next in line (disassembled), the top 13 words on the stack, and the status of certain options available in RAID. The contents of 96 consecutive bytes of memory may also be displayed in either hex or ASCII. All the usual debugging functions are provided, such as breakpoints and examine or modify registers and memory locations.

A nice feature about RAID and SCOPE is that they both have a 'help' feature which displays the available commands and their meanings on the screen. This is often sufficient to avoid the need to refer to the manual.



A close-up of the VIP's S100 rack.

Other utilities are provided for formatting disks, making backup copies (taking about four minutes with a single drive), testing memory and determining whether ROM, RAM, or no memory is present in each page. The final utility is a system configuration program. This allows the use of a number of different types of printer without having to go into the depths of the operating system (although the source code of the user area of the BIOS is supplied on disk) and makes it easy to set up a turnkey system which will automatically run a program when the system is booted. Also on the distribution disk is a program which gives a very effective demonstration of the capabilities of the Flashwriter board.

Version 5.1 of the well-known Microsoft interpreted Basic is the only high level language suppled with the system. Other languages available include Cobol, Pascal, and APL.

By the time this article appears, Almarc expects the widely-praised Visicalc to be included in the standard package. A selection of applications software is also available at additional cost from Almarc. These include purchase, sales and nominal ledgers, stock control, and payroll. I was supplied with a copy of the payroll demonstration disk and it appears to be well-designed and easy to use. The programs are menu driven and it is easy to get back to an outer level if you accidentally enter the wrong command. As I once worked as a payroll clerk, I recognise that the program provides the required facilities in a usable format. I think the year-end analysis function would prove particularly useful, because, due to its otherwise time-consuming nature, this is a task which is not always given as a high priority as the Inland Revenue would like!

A final piece of software supplied with the review system was the Word Management System (WMS), a word

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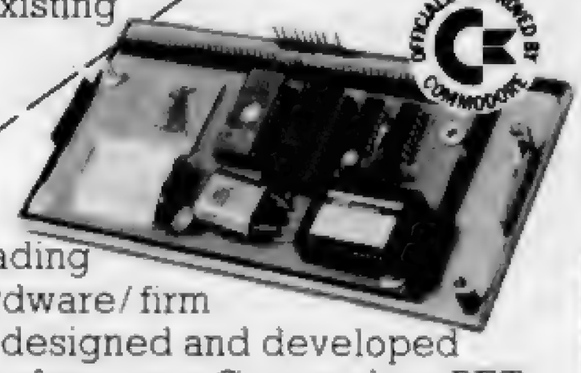
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processing program. As this is a useful function which utilises virtually all the hardware, I spent most of the time using it, including the preparation of this manuscript (my thanks to Almarc for the loan of a Qume Sprint 5 daisywheel printer). To see how a non-computer person would get on with the system, I turned the machine over to a secretary for a day. She was tremendously impressed and even after such a short period of use was wondering how to cope without it. My own feelings about the program are almost as favourable, although I prefer to use word-processors which display the text as it will be printed (WMS simply maintains an 80-column display with a ragged right edge and format controls shown by graphic characters). A useful facility not present in this program is the ability to edit one file while another is being printed. On the positive side, a minimum usable subset of the commands can be learnt in about 15 minutes, all the features found on daisywheel printers are supported and a mailing list module is included to allow the preparation of personalised form letters. These mailing lists may be sorted into alphabetical or numeric order and each entry may be allocated to any of 26 categories. WMS currently runs under MZOS (Vector's own operating system) but I am told that the next release of WMS will run under CP/M and will contain a number of significant enhancements.

Documentation

Two manuals are supplied, one each for hardware and software. Both are loose-leaf binders with index tabs dividing the various sections. Unfortunately, some sections of the hardware manual were lost or delayed in the post but those parts I did see were easy to understand, being written at three levels. The first explains what the unit (eg the RAM board) does, the second how to use it and the final part covers the theory of operation and includes circuit and schematic diagrams.

The software manual is based around the Digital Research CP/M manuals, with additions to describe the Vector software and modifications. Although these additions are arranged in a similar way to the Digital Research documents, they are less terse, making them easier to understand on the first reading. I found the general lack of indexes irritating, although the Basic manual has one. At least the WMS manual has a table of contents, although this is second-best to an index.

Expansion

Up to three additional drives may be daisy-chained onto the original but if this is inadequate for your needs, then either the Microstore subsystem giving two megabytes of storage on twin 8in double density drives can be added, or the 32 megabyte hard disk which will be available in the near future. Alternatively, complete systems in these configurations may be purchased. They are the System 2800 and the System 3030 respectively. Up to four hard disk drives can be connected to a single system.

As already mentioned, there are two spare S100 slots available for system expansion. One of the disk controllers mentioned above could be added, but any of the huge range of S100 cards could be installed. The availability of bank selected memory means that large (ie over 64k) programs may be run, although this tends to be tricky when using high level languages but I have heard that it is possible to modify the Microsoft link-loader to accomodate this feature.

The provision of serial and parallel interface circuits on the standard VIP makes it possible to connect most peripherals to the system, although some extra cost is involved in making use of the parallel ports — about £35 for all the cables and connectors required to hook up a Centronics printer.

Potential

If fitted with a second disk drive, the VIP would be a useful business system due to the existence of commercial software written especially for the machine as well as the number of CP/M compatible programs. It is clear that this is the target market for this stylish machine, which looks perfectly at home in any office.

Whether or not it is suited for domestic use largely depends on your idea of 'home computing' — but something like the Apple II is more likely to fit the bill. Similarly, its usefulness in a laboratory or in schools is limited due to the restricted graphics and interfacing ability.

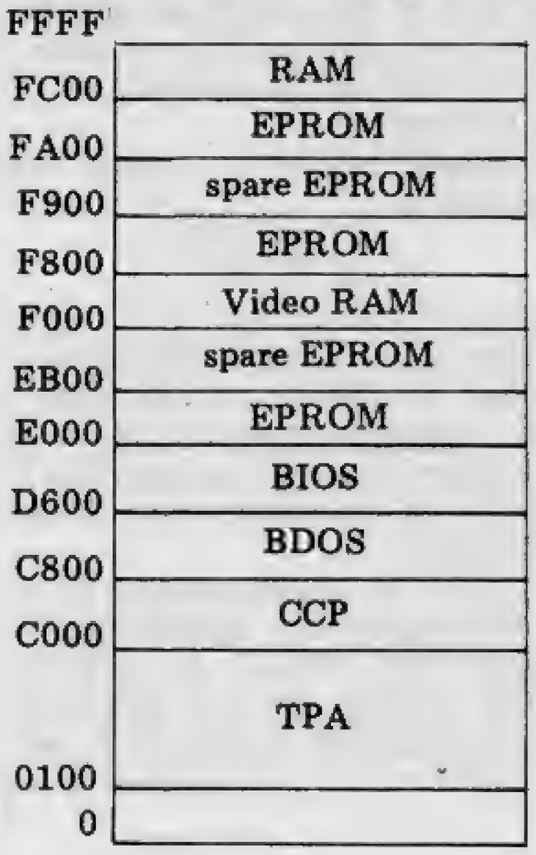
Conclusion

The VIP is a solid machine which performed perfectly throughout the test period. What it does, it does very well, but it does not offer any significant advantages over the competition. In particular, this computer cannot compete with similar machines on the basis of price. Consider the Superbrain, which costs about £500 less, or the TRS-80 Model II which is roughly the same price as the VIP but has an 8in disk drive giving more storage, three complete I/O ports (two serial, one parallel) and terminal-emulating software. The VIP's advantages are the flexibility and ease of expansion given by the S100 bus and CP/M, plus some very useful extra software, but the value of these depend on the purchaser's precise requirements.

Prices

VIP	£2125
Microstore	£1063
Hard disk subsystem	TBA

Memory map



Benchmark timings (in seconds)

	Integer	Single Precision	Double Precision
BM1	1.0	1.0	—
BM2	3.0	3.8	4.9
BM3	10.9	10.9	39.1
BM4	10.7	10.7	39.9
BM5	11.6	11.6	40.5
BM6	18.2	20.5	49.5
BM7	27.1	32.7	61.1
BM8	3.4	3.4	3.4
DT1		1.2	
DT2		49.8	
DT3		58.5	
DT4		11.3	
DT5		17.6	

Technical Data

CPU:	Z80A, 4 MHz
Memory:	64k dynamic RAM (56k usable), 2k video RAM, 1k scratch-pad RAM, 3.5k ROM
Keyboard:	Capacitance switched, 72 keys
Screen:	12in diagonal
Disk drive:	Single Micropolis 77 track, 5¼in, 315k capacity
Bus:	S100
Ports:	1 RS232, 3 8-bit parallel (or 2 parallel with handshaking)
System software:	CP/M 2.2
Languages:	Basic (others available at extra cost)
Dimensions:	13in high x 18in deep x 21in wide, weight 22lbs

At a glance

For a variety of reasons we have decided to abandon our 'star' ratings in favour of a brief written summary — this will be done with all our Bench-tests from now on.

The VIP has good looks and ease of use in its favour, although setting up was average.

The system software was good and the Basic excellent — other languages were not tested. The availability of CP/M means that a wide range of software is available to run on the system. Full versions of the packages available for the VIP were not tested, apart from the WMS word processor, which was good.

On the hardware side, the VIP has an S100 bus, which allows a great many products to be slotted in. Scope for memory and disk expansion is good.

Compared to some other machines, though, the VIP does not offer particularly good value for money.

PATTERNS

This month we introduce Alan Sutcliffe, a computer consultant who has a special interest in computer art and music. He was the founder of the Computer Arts Society and is currently a vice president of the British Computer Society. In this series, he discusses the use and generation of patterns and numbers in various applications. The series will be practical, with programming examples given at every opportunity and, inevitably, a certain amount of the underlying mathematics. If you should feel moved to join in and contribute to the series then write to Alan c/o PCW, 14 Rathbone Place, London W1P 1DE.

In this first article I explain how the Random function can be used to generate values with various kinds of distribution. After some general thoughts on randomness and structure, I go into the mathematical theory of applying functions to a random variable. The last part of the article gives an example program to illustrate the methods.

Patterns in randomness

There are all kinds of reasons for wanting to generate a pattern of numbers. It may be to compose a tune or synthesise a picture, it may be to make choices in a syntax tree for writing poems, or it may be to bet the initial positions of pieces in a game, or to provide values to drive a simulation, or it may be to try possible sets of values in the solution of a puzzle.

One of the most common ways to generate values is simply to call the system's own random number generator. This can produce interesting patterns. We are naturally pattern seeking and pattern recognising beings. Generate seven numbers at random and you no longer have randomness, you have a pattern. Any seven marks on a piece of paper make a pattern. On a cosmic scale, the stars in the sky are distributed more or less at random, excluding the Milky Way. Yet they are full of signs and symbols, gods and beasts, myths and meanings.

One set of seven stars is seen by different people as a dipper, a plough, a great bear. In Mongolia, it is known as the Seven Old Men, and it used to be invoked as the god of destiny. It seems that almost every culture recognises something in that random constellation.

However, straightforward randomness can become boring. The celestial display is enlivened by the bodies of the solar system and the clustering of stars in our own galaxy.

No computer system has a display than can rival the grandeur of the night sky. What we lack in splendour can be made up for by applying a bit of method.

Most natural objects — leaves, trees, rocks,waves, feathers, clouds — combine structure and randomness. It is the inter-lay between these two that we find attractive, the structure providing a theme and the randomness variations. It is useful to think of these properties of things in the real world when using a computer to make compositions, even though the result appears entirely abstract.

Applying a function

I shall assume that the Basic function RND provides values uniformly distributed in the range 0—1. Any number from 0 to 1 is just as likely to occur as any other. The next part of the article explains how other distributions can be got, such as one where values near 0 are more likely to occur than values near 1. This is done by applying a function to the output from RND such as taking the square or the square root.

If you find the maths a bit daunting, I suggest you read the beginning of each section until it gets too steep and then step to the start of the next section. From a practical point of view the most important part of the article is the programs at the end, and to follow these a good place to start is the section headed Complex Distributions.

It is a simple matter to change the RND distribution:

```
X = RND (1)
Y = X * X
```

The function $Y = X^2$ has the useful property that when X lies in the range 0 to 1 so does Y. Clearly Y will have a distribution weighted towards the lower end of the range, since X^2 is less than X for the values in the range with which we are concerned.

It is not quite so simple, given a function, to determine the distribution it will produce. The rule is as follows: a. Take the inverse of the function, that is X expressed in terms of Y, and

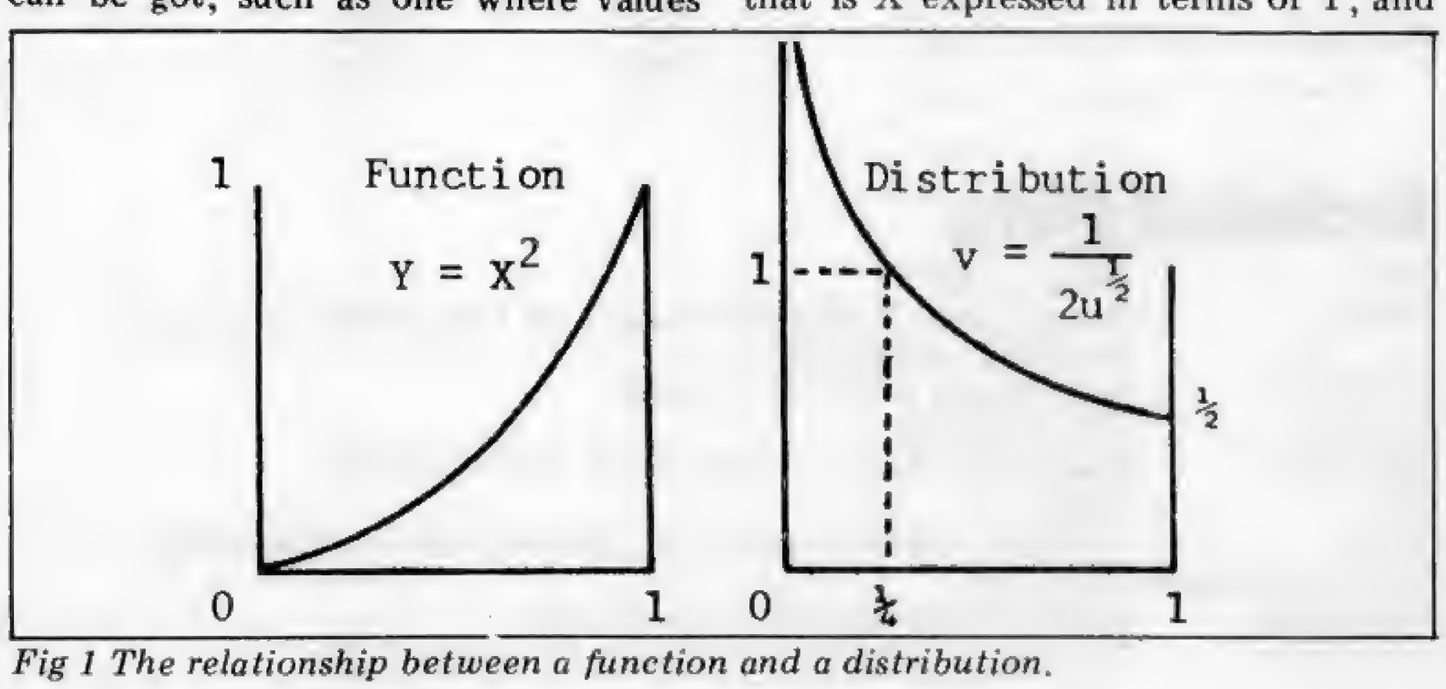


Fig 1 The relationship between a function and a distribution.

swap to new variable names u and v. This change in variable names is to avoid using the same variable for both the function and the distribution which might be confusing.
b. Differentiate this, dv/du, giving the distribution function.
A detailed demonstration of the correctness of this method given in the footnote at the end of this article.

An example will make the method clear:
Function $Y = X^2$
Inverse $X = Y^{1/2}$, rewritten $v = u^{1/2}$
Differentiate $D = \frac{dv}{du} = \frac{1}{2} u^{-\frac{1}{2}} = \frac{1}{2\sqrt{u}}$

The curve of

$$v = \frac{1}{2\sqrt{u}}$$

passes through the points (¼, 1) and (1, ½) but at x = 0 it shoots off to infinity, as shown in Figure 1. At first this may seem puzzling — does it mean that an infinite number of the values of X * X will be zero? Clearly not: it is the area under the curve that is important and a curve that goes off to infinity can still have a finite area under it; as this one does. Indeed the area under the whole curve from 0 to 1 is unity, as it should be for any well-behaved distribution. This is equivalent to saying that the probability of a value lying in the range 0 to 1 is unity, that is, it is certain to do so.

Function	Inverse	Distribution
X	u	1
X^2	$u^{1/2}$	$\frac{1}{2}u^{-1/2}$
X^3	$u^{1/3}$	$\frac{1}{3}u^{-2/3}$
X^n	$u^{1/n}$	$\frac{1}{n}u^{\frac{-n-1}{n}}$
$X^{1/2}$	u^2	$2u$
X	u^n	$n\,u^{n-1}$

Table 1

Find the function

It is also possible to start with a distribution and derive the function that produces it. The process is the converse:
a) Given v = F(u) as the equation of the desired distribution, integrate this to give $G(u) = \int F(u)du$.
b) Change to new variables such that X = G(Y). Note: this is again to avoid confusion! Then take the inverse of this function to give the one required: $Y = G^{-1}(X)$.

As an example of this procedure, suppose that the distribution wanted is a simple increasing one, a straight line passing through the origin: v = Au. To ensure that the area under this line between 0 and 1 is unity, A must take the value 2, making the function simply v = 2u, as shown in Figure 2.

```
100 DIMENSION C(10)              Ten bins for the distribution
110 FOR K=1 TO 10                Set the number in each bin to zero
120 C(K) = 0
130 NEXT K
140 FOR I=1 TO 1000              Main loop to generate values
150 J = RND(1)                   Generate a random number
160 J = J*J                      Apply for function
170 FOR L=0.1 TO 1 STEP 0.1      Assign this value to its bin
180 K=10*L
190 IF J<=L THEN 220             Jump out if it is this bin
200 NEXT L
210 GOTO230                      This point should never be reached
220 G(K)=C(K)+1                  Add one to the bin count
230 NEXT I                       Return for next value
240 FOR K=1 TO 10                Print the final bin totals
250 PRINT K,C(K)
260 NEXT K
270 FOR K=1 TO 10                If there is a plotter draw the
280 MOVE K,0                     histogram: the values of K and
290 DRAW K,C(K)                  C(K) may need scaling to fit the
300 NEXT K                       plotter
```

Program A

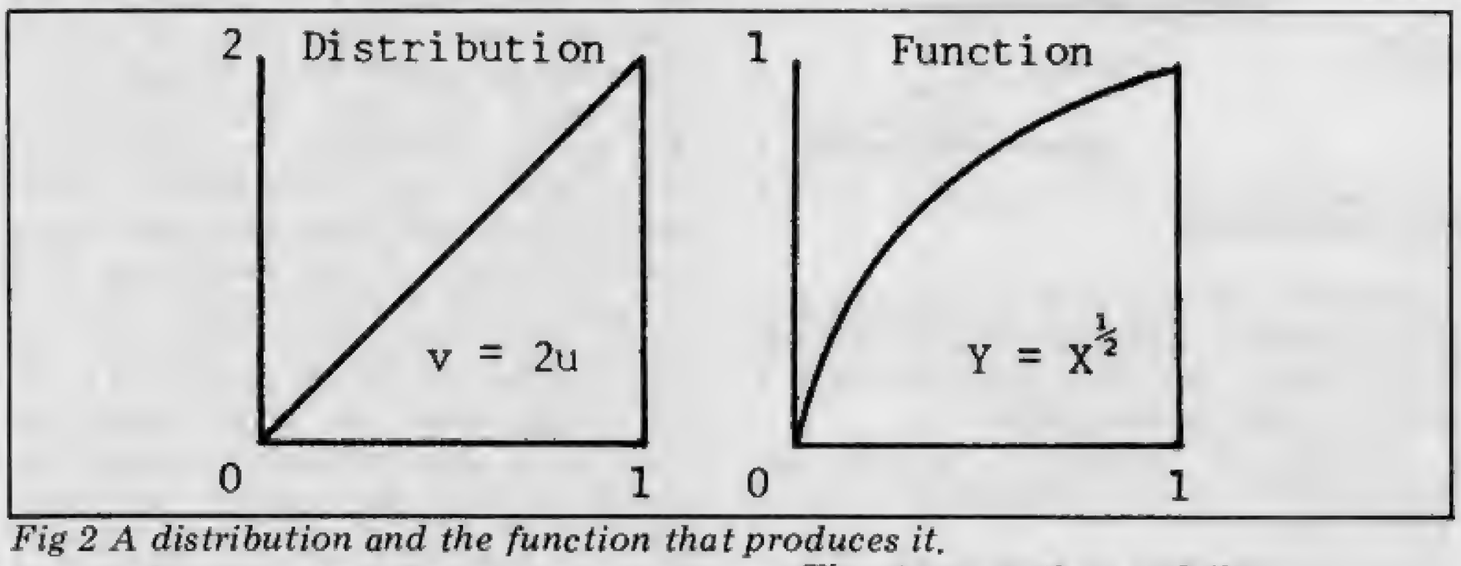


Fig 2 A distribution and the function that produces it.

The steps are then as follows:
a) Integrate: $2udu = u^2 = v$
b) Change variable names: $X = Y^2$
and invert the function: $Y = X^{1/2}$

The required function is thus the square root and all that is needed to produce a random variable in the range 0 to 1 with the distribution v = 2u is R = SQR(RND(1)).

It is not always easy or even possible to differentiate or integrate a function, or to find the inverse of a function. You may not be able to carry out the process of getting from distribution to generating function, or its reverse, starting from a particular distribution or function that you may choose.

Numerical method

However, it is always possible to get a picture of the distribution that arises from a given function by using a numerical method. Just generate a large number of random values, apply the function to each one, determine the sub-range in the distribution that this value falls into and increase a counter for the total number of values falling into that sub-range. In this way a histogram of the distribution can be built up. Program A does the job for 1000 samples and ten sub-divisions of the range. It can easily be adapted to other cases.

Staying in range

All the functions considered so far have the convenient property that their values lie in range 0 to 1 when the original variable does. It is natural to want to exploit the other built-in functions of your system, such as LOG, EXP or SIN, to produce distributions. Take Y = EXP (X) as an example:

For X = 0, EXP(X) = 1
For X = 1, EXP(X) = e = 2.718...
So, for the sake of uniformity, to reduce the new variable to the same range of 0 to 1, a little extra arithmetic is needed:
D=EXP(1)—1 (Set e — 1 at the start of the program)
R=EXP(RND(1))
S=(R—1)/D (Separated into two lines for the sake of clarity)
In mathematical terms the function is

$$Y = \frac{e^x - 1}{e - 1}$$

To derive the distribution corresponding to this, first obtain the inverse function $v = \log((e-1)u + 1)$. Then differentiate this to give:

$$\frac{dv}{du} = \frac{e-1}{(e-1)u + 1.}$$

To check that this has the required property of having unit area below the curve between 0 and 1, calculate the integral:

$$\int_0^1 \frac{e-1}{(e-1)u+1}\,du =$$

$$[\log((e-1)u+1)]_0^1 =$$

$$\log(e) - \log(1) = 1$$

The distribution is shown in Figure 3. You will see that it has a moderate bias towards zero, with numbers near 0 occuring about e times more frequently than those near 1.
For u = 0, v = e — 1 = 1.72...
For u = ½, $v = \frac{2e-2}{e+1} = 0.92...$
For u = 1, $v = \frac{e-1}{e} = 0.63...$

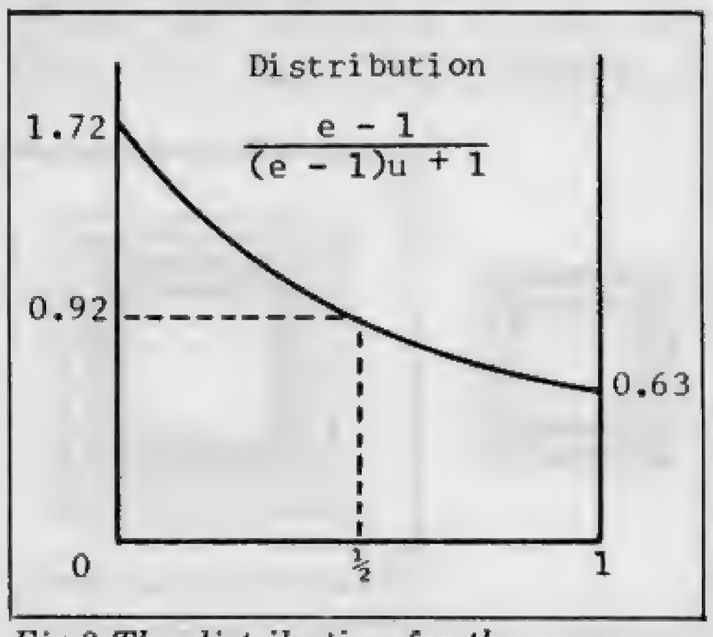


Fig 3 The distribution for the exponential function.

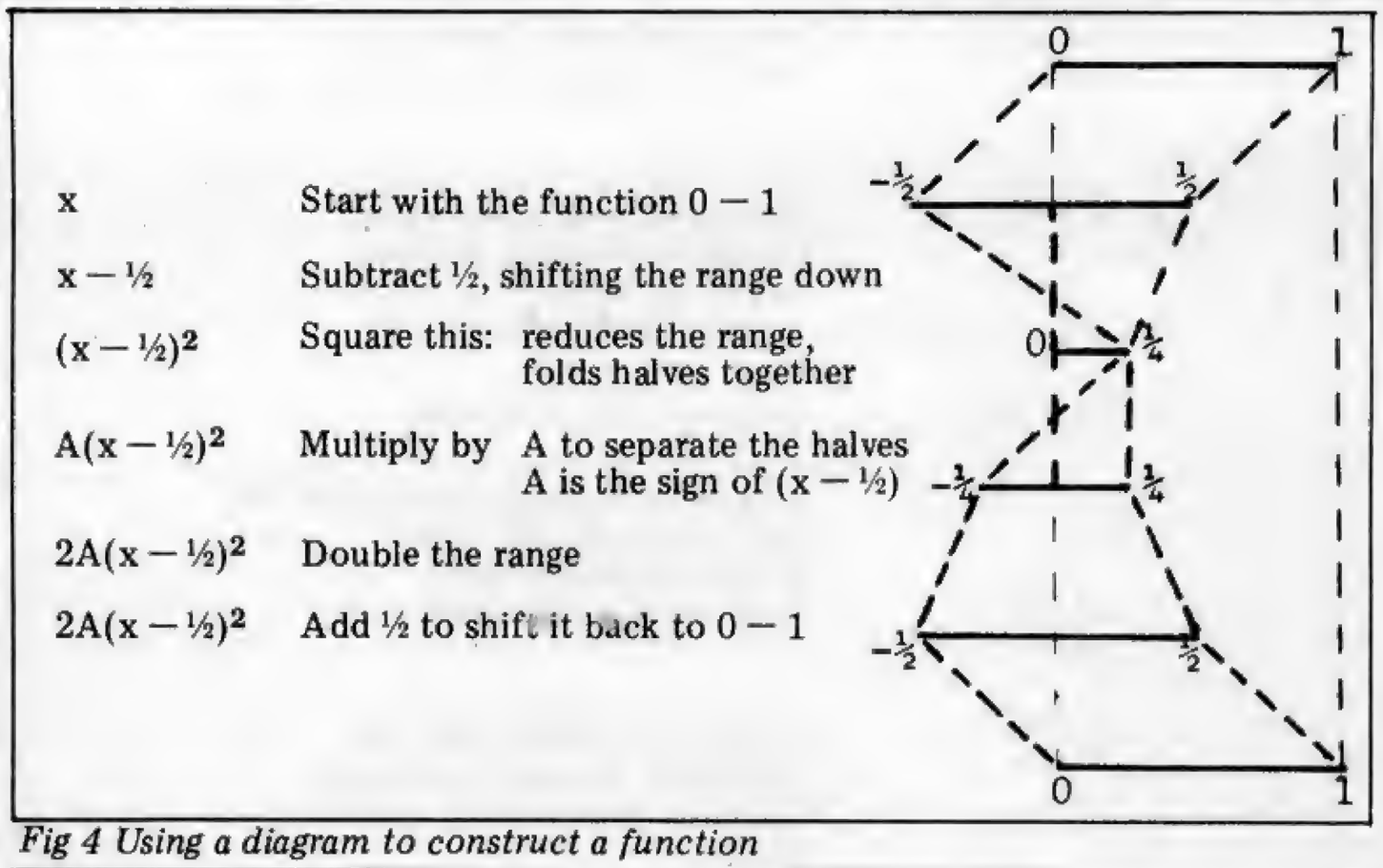


Fig 4 Using a diagram to construct a function

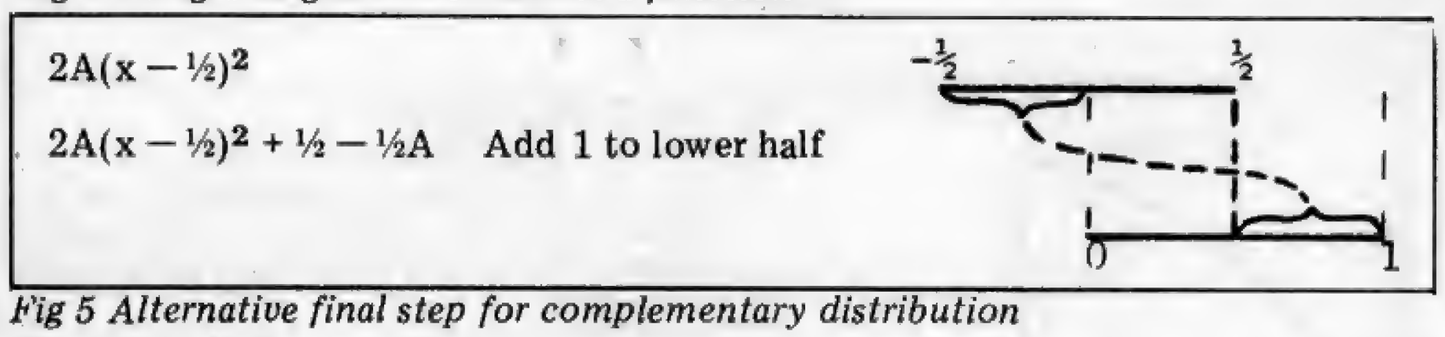


Fig 5 Alternative final step for complementary distribution

Complex distributions

So far all the distributions have been simply increasing or decreasing. There is one more method I have used to construct functions of a single random variable, which can be used for more complex cases. Suppose the exact shape of the distribution is not too important, only its general form. One with its peak in the middle and lowest points at the extremes is a good example — something like the normal curve of statistics but with its two tails cut off. I want to use simple algebraic expressions to keep computing time to a minimum, since this is a routine I shall want to use very often. I want to make use of the fact that the squares of a random number less than 1 are bunched towards zero, as seen in Figure 1. A diagram is used to keep track of the function and to ensure that it ends up in the right place. This is illustrated in Figure 4. In this particular case A = sign of (x — ½) is used:

A = 1 if x — ½>= 0

A = —1 if x — ½<0.

It will be seen from the diagram that the function to use is

$2A(x-½)^2 + ½ =$

$2Ax^2 - 2Ax + ½A + ½.$

Although it is possible to establish functions like this one by algebra alone, I find it very much easier using a diagram. The code to implement this formula is straightforward. With one small change to the last step it can be made to generate a complementary distribution, that is, one with peaks at 0 and 1 and a trough in the middle.

Instead of adding ½ as the last step, add ½ — ½A, which is 0 if A = 1 and 1 if A = —1.

This has the effect of splitting the distribution in the middle and transposing the two halves, as shown in Figure 5. The function that results from this is thus:

$2A(x-½)^2 + ½ - ½A =$

$2Ax^2 - 2Ax + ½.$

Building a system

That is enough for one month about individual functions. I hope to write later about some specific statistical distributions such as the normal and Poisson, and about some distributions depending on two random variables.

We have now looked at a miscellany of functions, and seen how to ensure that the resulting values lie in the range 0 to 1. In general a different range will be wanted, say L to M, and this is achieved by the simple Basic expression R = L + (M — L)*R.

To make a useful system a selection of functions can be put together in one program. A set of five makes a good start, and program (B) gives these distributions:

N = 1 Uniform

N = 2 Sloping up

N = 3 Sloping down

N = 4 Peak in the middle

N = 5 Peaks at the ends

The program is entered with L and M set for the lower and upper limits of the range, and N = 1 to 5 for the distribution to be used. Distributions 2 and 3 use the square root function shown in Figure 2. To flip this from sloping up to sloping down all that is needed is to substitute 1 — R for R. Distributions 4 and 5 use the functions demonstrated in Figures 4 and 5.

I first used a scheme like this when I wrote a program to compose electronic music. Whenever a series of values was wanted, for the pitch, loudness, timing or tone colour of a note, for example, the routine was entered first to select three numbers for the range and distribution values, L, M and N. These values were then used to generate the numbers for a sequence of notes. The number of notes in the sequence had itself been chosen by another call to the routine. During a movement of the piece the same values of L, M and N were used to select the L, M and N that were used for each short sequence. This gave a uniformity to each movement, since it was controlled by parameters all chosen from the same range and distribution. I need hardly say that the parameters for this higher level of control were themselves chosen by the same mechanism, with values of L, M and N that were set at the beginning of the piece. Just one initial number was needed to seed the process, and from then on the whole thing generated a piece of the kind it had decided it should. The overall scheme was:

Choose L_0 M_0 and N_0 for the whole piece

Use these to choose L_1 M_1 and N_1 for each movement

Use these to choose L_2 M_2 and N_2 for each section

Use these to choose the individual notes in each section.

The program was written in Fortran and ran on an ICL 1905 in Putney. Its output was paper tape containing the values for all the individual notes. This was taken a few hundred yards across Putney Bridge to the electronic music studio of Peter Zinovieff, who had just installed a PDP-8 to control all his sound synthesis equipment.

Nowadays it would be called personal computing, but this was in 1967 and the term hadn't been coined. The piece won second prize in a contest at the 1968 IFIP Congress in Edinburgh. That was an occasion that led directly to the formation of the Computer Arts Society.

The program is too long to give here, even if I could find it in my filing

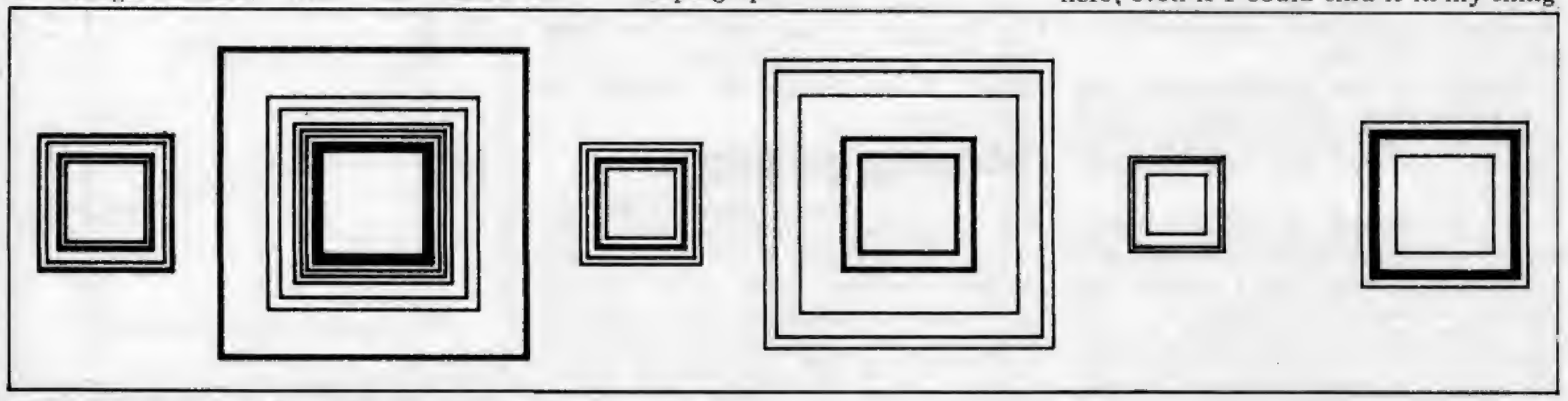


Fig 6 Sample output from Program C, structured randomness.

system — a cubic yard or two of piles of papers. Instead I have written a short graphics program (C) to illustrate the ideas. This draws six sets of concentric squares. For each set, values of L, M and N are chosen and then used to decide the number of squares in the set and the size of each one.

The output from a run of the program on a Tektronix 4051 is shown in Figure 6. The subroutine at 700 draws one square. The controlling values of L, M and N have given a mildly different appearance to each set of squares: more differentiated than if they had all been chosen with uniform randomness.

One useful bit of program (D) which I first used in the music project gives a series of values from a moving range. L1 and L2 denote the lower limits of the range at the start and end of the series, with M1 and M2 as the upper limits. Figure 7 shows the arrangement, with a set of eight points generated using N = 5, which was always my favourite distribution. C must be set with the number of points in the series before the subroutine is entered, together with values of L1, L2, M1, M2 and N.

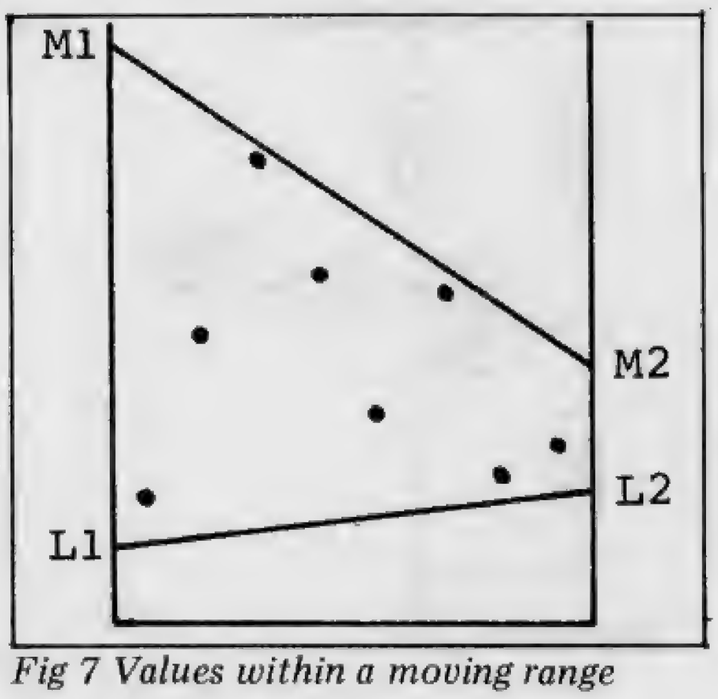


Fig 7 Values within a moving range

Footnote

Demonstration of the rule to derive a distribution from a function. Random numbers are generated in the range $0 \leqslant X \leqslant 1$ with uniform (equiprobable) distribution. The equation of this distribution is thus Y = 1, and the area under this line between 0 and 1 is unity. For a particular X = a, just a of the values of X will be less than a, as shown in figure 8. What is the distribution of X*X?

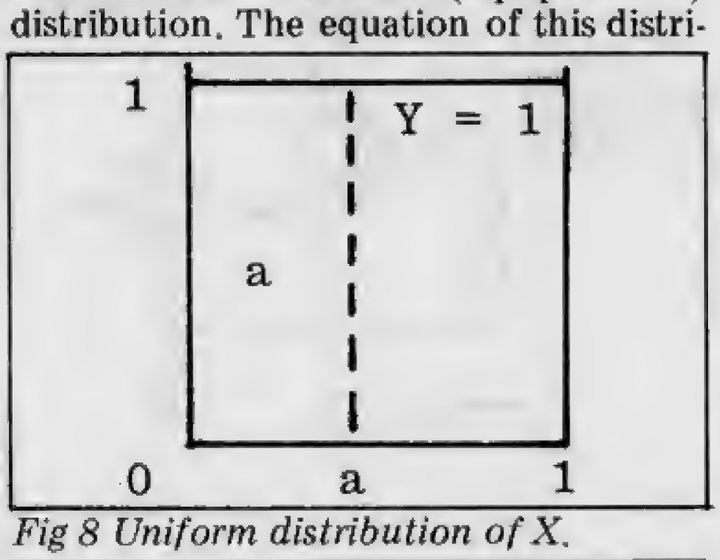


Fig 8 Uniform distribution of X.

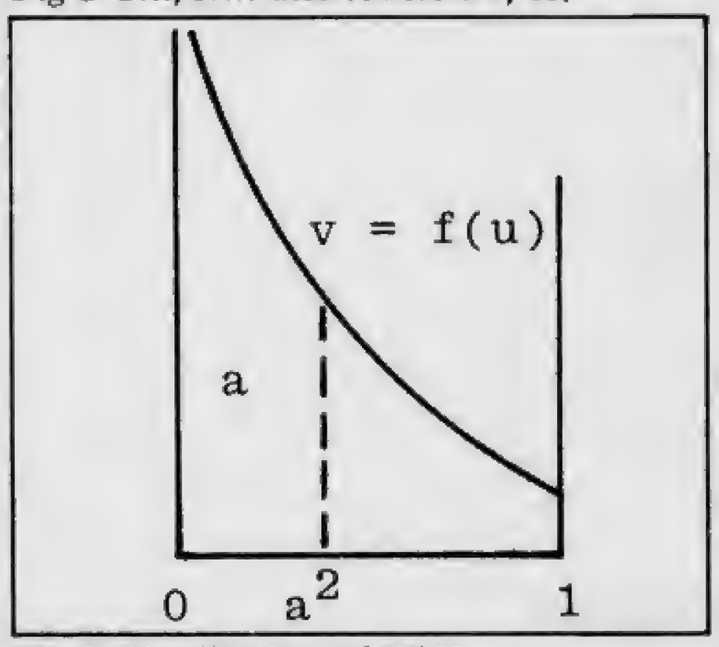


*Fig 9 Distribution of X*X*

In the distribution of X*X just a of the values of M*X will be less than a^2 for each a. That is, the area under the curve of the distribution from 0 to a^2 will be a, as shown in Figure 9.
If v= f(u) is the equation of this curve,

then $\int_0^{a^2} f(u)du = a.$

Substituting $b = a^2$ gives

$\int_0^b f(u)\,du = b^{½}.$

The next step is to find the function f(u) which has the integral $b^{½}$ over the interval 0 to b. Since this is a definite integral the constant terms cancel out. Now —

$\frac{d}{du}(u^{½}) = ½u^{-½},$

so that

$\int_0^b ½u^{-½}\,du = [u^{½}]_0^b = b^{½}.$

Hence $v = f(u) = ½u^{-½}$ is the required function, obtained simply by differentiating the inverse of the original function F(X).

Switching between the variables X, Y and u, v may be a bit perplexing, though it is meant to avoid confusion. One set is for the function and the other for the distribution. Remember that a function is not changed by the names of the variables used to express it. $f(x) = x^2$ is the same function as $f(a) = a^2$.

```
790 REM
792 REM SUBROUTINE TO PRODUCE
794 REM 5 DIFFERENT RANDOM
796 REM DISTRIBUTIONS
800 R=RND(1)                      Call random function
810 IF N=1 THEN 930               Jump for uniform distribution
820 IF N>3 THEN 870               Jump for N = 4 or 5
830 R=SQR(R)                      Take square root of R
840 IF N=2 THEN 930
850 R=1-R                         Invert if N = 3
860 GO TO 930                     Jump to set range
870 A=1                           Set sign of (R — ½)
880 IF R>0.5 THEN 900             Test
890 A=-1                          and reset
900 R=A*(2*R*(R-1)+0.5)+0.5       Compute function
910 IF N=4 THEN 930               Complete if N = 4
920 R=R-A/2                       Adjust final term
930 R=L+(M-L)*R                   Set range
940 RETURN
```

Program B

```
90 REM PROGRAM TO DRAW SQUARES
95 REM USING RANDOM STRUCTURES
100 FOR Z=1 TO 6                  Draw 6 set of squares
110 L=1                           Set limits to choose
120 M=6                           new L, M, and N
130 N=1
140 GOSUB 800
150 I=INT(R)                      Get new L
160 GOSUB 800
170 J=INT(3*R)                    Get new M
180 GOSUB 800
190 N=INT(R)                      Get new N
200 L=I
210 M=I+J                         Copy L
220 GOSUB 800                     and M
230 J=INT(R)
240 FOR I=1 TO J                  Choose no of squares
250 GOSUB 800
260 GOSUB 700                     Loop for each square
270 NEXT I                        Chooses square size
280 NEXT Z                        Draw 1 square
290 STOP
700 S=R/2                         Set constant
710 MOVE @1:12*Z-S,12-S           Move to corner of square
720 RDRAW @1:R,0                  Draw the square
730 RDRAW @1:0,R
740 RDRAW @1:-R,0
750 RDRAW @1:0,-R
760 RETURN
```

Program C

```
390 REM SUBROUTINE TO PRODUCE
392 REM DISTRIBUTIONS WITH A
394 REM MOVING RANGE
400 J=L2-L1                       Set range differences
410 K=M2-M1
420 FOR I=1 TO C                  Loop for C values
430 D=(I-0.5)/C                   Calculate range for
440 L=L1+J*D                      this point
450 M=M1+K*D
460 GOSUB 800                     Choose value in range
470 NEXT I
480 RETURN
```

Program D

PRINTERFACING

Peter Faff continues his series on hooking low-cost printers to micros.

The first unit I will look at this month is the DP-822 impact printer mechanism, produced by Star in Japan and available through Roxburgh Printers Ltd for about £45. The unit uses standard 2¼ x 2¼in grade 'A' calculator paper and group 24 ribbons. The maximum printing field is 21 5 x 7 characters at two-and-a-half lines per second; the only power supply required is 12 V at approx 3 A and the unit is fairly small.

The print is built up column-by-column in a serial format by a seven-element print head. The head only prints while moving from left to right — during the return stroke, paper feed is accomplished. The print head is moved across the paper by a rotating shaft with a spiral groove cut into its surface — there are no belts or wires that can snap or slip. A 12 V DC motor provides the power for the print head traverse, the paper feed and the ribbon advance.

In use, the printer generates two timing signals. The first signal Print Active (PA) is generated by a magnet and reed switch. This switch is held closed during the entire print cycle and it should be used to determine when to start printing. When the reed is opened the motor should be turned off, or if another line is to be printed the motor should remain energised and the control logic must wait for the reed to close again before starting to print the next line of characters. The second signal, Dot Position (DP), is provided by a detector coil and rotating magnet. This provides a pulse for each column of dots during the print cycle. Since the printer can print 21 5 x 7 characters with a one-dot space between them, a total of 126 pulses will occur during each print cycle. Both of these signals will need to be further conditioned before they are of any use: the PA signal generated by the reed switch will need to be de-bounced and the DP signal, which is a 0.2 V p-p sine wave, will need to be amplified and clipped to provide a square wave pulse train — see Figure 1 for suggested circuits. This machine also has a paper feed solenoid and in order to feed the paper, the solenoid should be tripped and the motor drive will be transferred to the paper feed shaft; paper feed should occur during the print head return stroke. The motor control circuit should incorporate an electronic break to ensure that the motor comes to a quick stop when the motor drive is turned off. The final part of the printer is the needle head, comprising seven solenoids and needles in an easily-replaced housing. The solenoids have a resistance of 3.6 ohms each and they draw a peak current of 2.5 A from 12 V supply. The solenoids require a pulse with a width of 730 us ± 10 us to be energised — again Figure 1 gives suggested drive circuits.

From Figure 1, you can see that the circuits are reasonably simple but, by all means, feel free to experiment. This printer prints characters column by column in a serial format (see Figure 2) and, because of this, the interface and control electronics that are required are reasonably simple. Figure 3 gives a suggested block diagram of the control circuit. The two major units are the character counter and the column counter. The character counter counts from one to 21 and determines which character is to be printed. This counter is reset when the print cycle is started and is then incremented by the DP signals. After six DP pulses, the counter increments by one, thus keeping track of which character is to be printed. The second major unit is the column counter, which keeps track of which column is to be printed. This circuit again runs off the DP line and counts from one to five as it receives DP pulses. The sixth DP pulse resets the

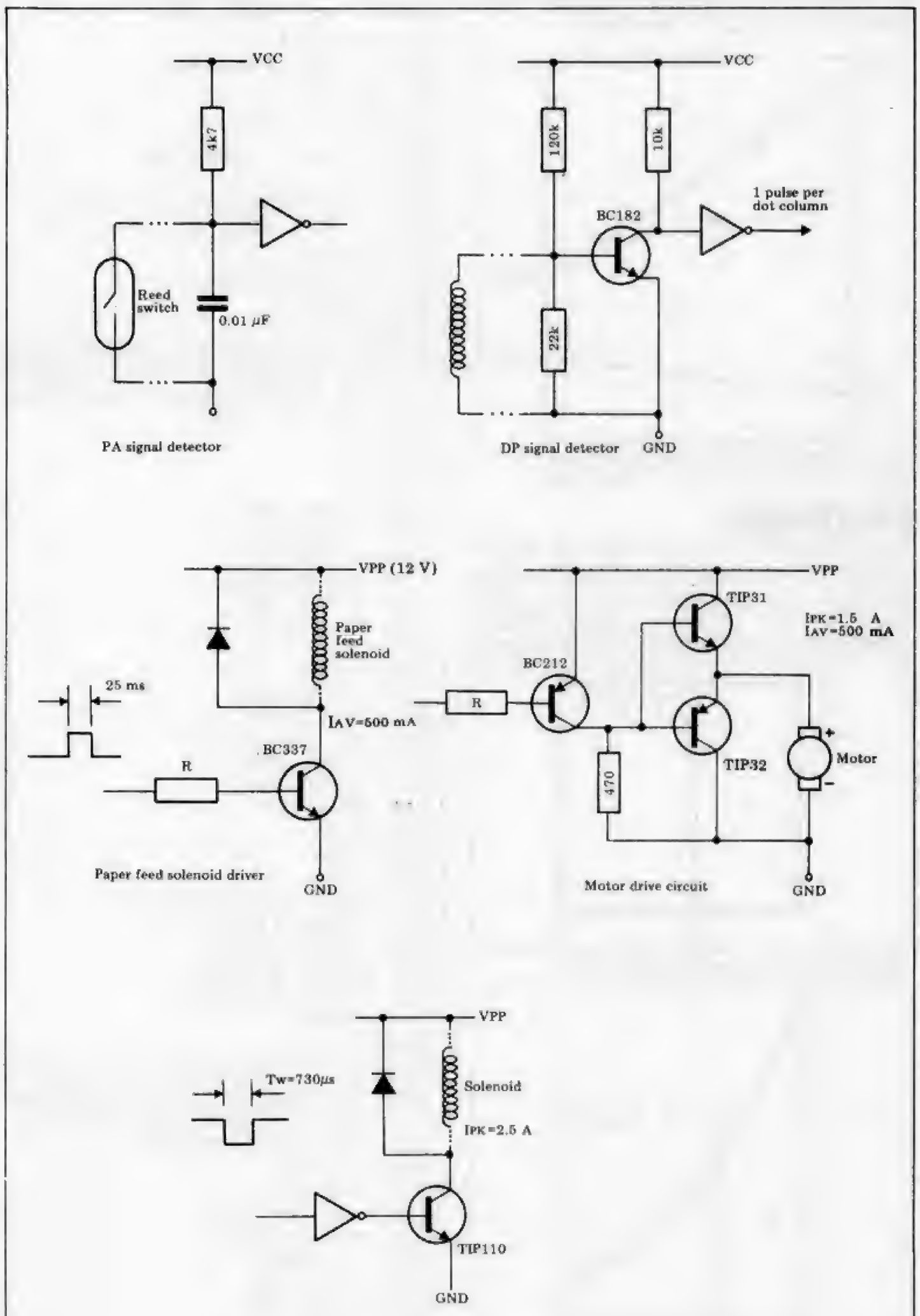


Fig 1 Suggested interface circuits

counter and, in this way, 5 columns are printed, followed by a one-dot gap and then another group of five columns.

The DP signals also feed a monostable that generates the 730 us pulse required by the print solenoids. The character generator should be of the type that stores 5 x 7 character cells as 5- 7-bit columns. The particular character being printed is selected by a 5-bit address and a further 3-bit address selects one of the 7-bit columns to be output. When the print cycle is started, the first character is selected by the character counter and the data for the first column are output to the solenoid drivers. The data for the other columns then follow until five columns have been printed; the character counter then selects the next digit stored in the line RAM and a further five columns are then sequentially printed. This continues until all 21 characters in the line have been printed, after which the cycle should be stopped.

National EUY series non-impact mechanisms

The National EUY series is a range of three basic types of printer. Each type is available in thermal or electro-discharge versions. All the printers use a serial print head that scans the paper printing characters column by column; printing only takes place in one direction. A choice of line widths is available, ranging from 15 to 80 characters per line between the three units. The mechanisms are all compact and consume little power. They should also be reasonably reliable because they are made by a reputable Japanese company. All the printers are available from Datac Ltd and the prices for the six basic units are:

EUY — 2E (285) Electro-discharge, 15 char	£25
EUY — 2T (295) Thermal, 15 char	£35
EUY — 10E (245 L/R) Electro-discharge, 32 char	£59
EUY — 10T (255 L/R) Thermal, 21 char	£89
EUY — 5E (265) Electro-discharge, 80 char	£119
EUY — 5T (275) Thermal, 80 char	£155

Since these printers use a serial print head, the control circuit required will be similar to that used by the DP-822 impact printer described elsewhere this month, although there will be some differences due to the different line widths used and also due to the different timing signals that are generated. Providing these factors are taken in to consideration, then the overall concept is similar and should pose no problems for the hardened constructor (think of driving a dot-matrix LED display).

The smallest printers in the series are the EUY 2E/2T. They are both 15 character per line printers, are physically quite small and they incorporate a roll holder in the printer frame. Connections to these units is by means of a 13-way flexible connector. These printers only generate one timing signal, produced by a rotating slotted disc and a photo transistor/LED assembly. Also incorporated in this detector unit is a shutter, coupled to the drive train; when the print head is in the correct position to print a new line, the shutter moves out of the light path, thus allowing the photo transistor to produce a pulse train. Each pulse corresponds to a dot column position and when the print head reaches the end of the line the shutter again moves into the light path and stops the pulse train. To determine which character is to be printed, you must count these pulses and you must remember to allow for a space between each character and the next. Both units have 5 V DC motors that require approximately 200mA. The print head on the electro-discharge printer requires a supply of 30 V at 50 mA per dot while the thermal print head requires 5 V at 270 mA per dot. Figure 4 gives the connector outline for these two units.

The next printer in this series is the EUY 10E/10T mechanism. This mechanism is slightly larger than the EUY 2E/2T series but it can print up to

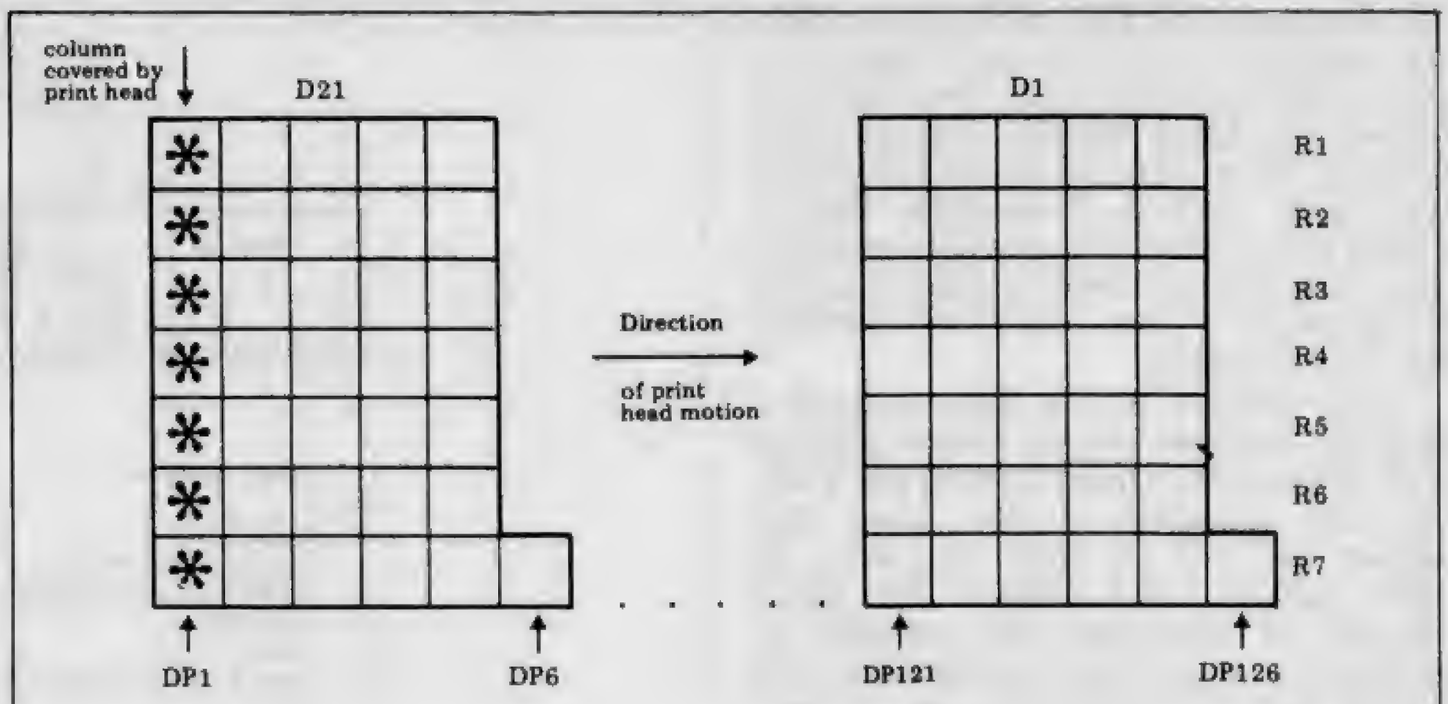


Fig 2

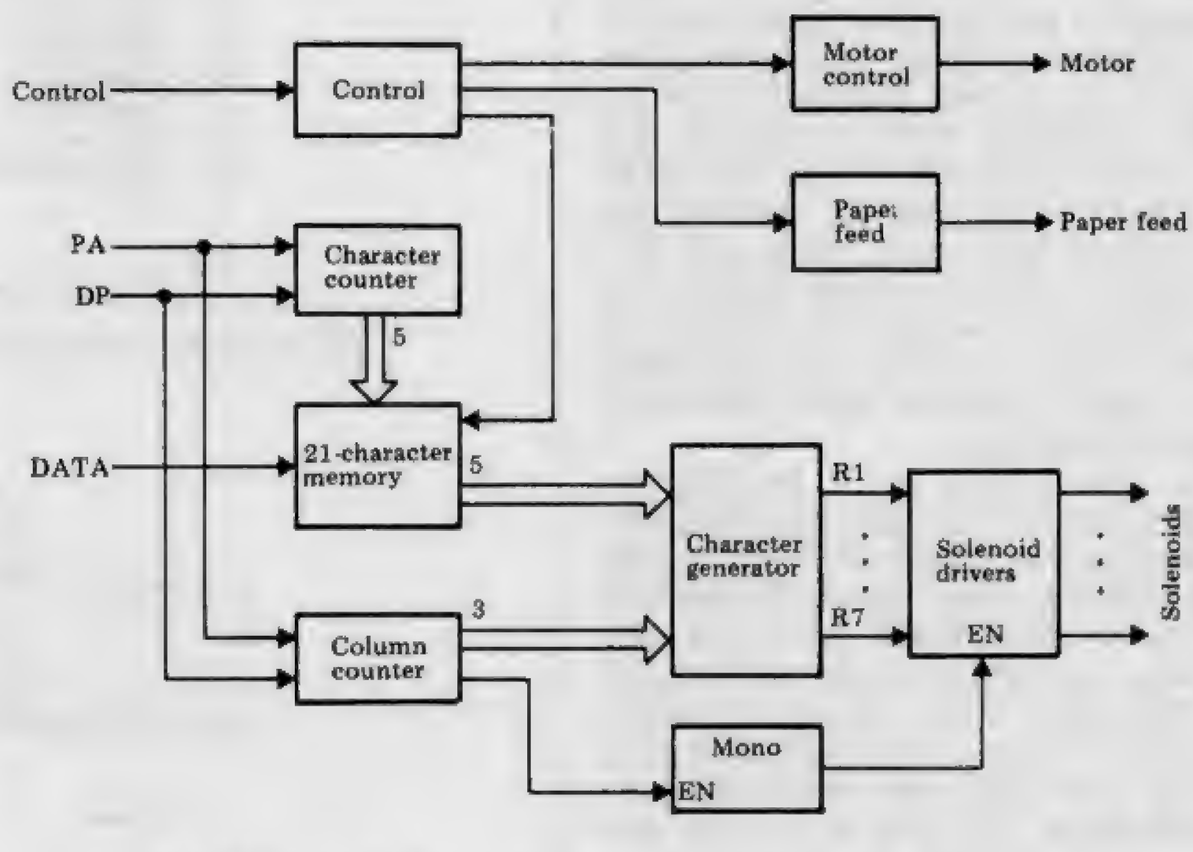


Fig 3 Block diagram of suggested control circuit



Pad	Thermal	Electrosensitive
1	Head common	Electrode 7 bottom
2	Element 6	Electrode 6
3	Element 4	Electrode 5
4	Element 2	Electrode 4
5	Element 1 top	Electrode 3
6	Element 3	Electrode 2
7	Element 5	Electrode 1 top
8	Element 7 bottom	Paper roller (electrode common)
9	LED (cathode), phototrans (emitter)	Phototrans (emitter)
10	Phototrans (collector)	Phototrans (collector)
11	Motor + ve	Motor + ve
12	Motor — ve	Motor — ve/LED (cathode)
13	LED (anode)	LED (anode)

Fig 4 Pin-outs for FUY 3E/2T printers

32 characters per line. Both these units are available in left or right hand versions which gives the user the choice of having the paper emerge with the last printed line at the top or the bottom of the paper strip as it emerges. This is useful if you intend to panel-mount the unit. The printer head is moved across the paper by a wire loop which is driven by the drive train.

Also coupled to the drive train is a rotating toothed wheel and a pick-up coil. When this wheel rotates, the pick-up coil generates a sine wave that allows the user to determine when to print the next dot column. The signal should be amplified and clipped to produce a square wave pulse train; this should then be divided by two to produce the dot print signal. This mechanism also generates a second signal to indicate the start and finish of a line. This signal is produced by a reed switch and a shielded magnet; when the print head is in the correct position to start a line the magnetic shield is moved, the reed switch closes and when the print head comes to the end of the line the shield moves back into place and the reed opens. When the reed opens, the motor should be turned off, unless you intend to print another line immediately, in which case you must wait until the reed closes again.

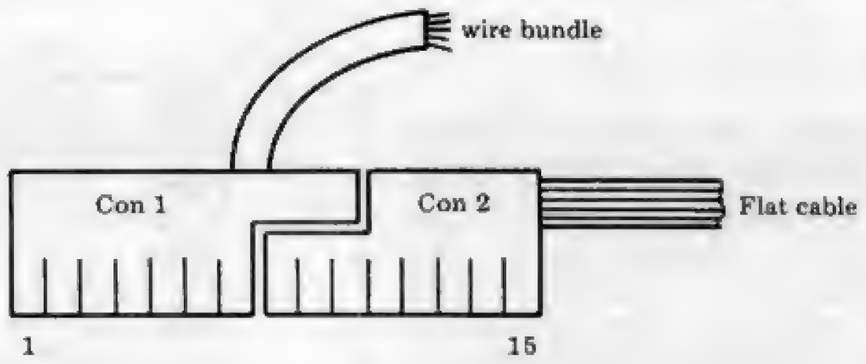
With this printer it is possible to factory preset the number of characters by changing the number of teeth on the rotating timing wheel. Since this printer also uses a serial print head you can again use a modified version of the DP 822 controller. Both versions operate from a 24 V supply, the motor drawing 100 mA and the print head dot elements drawing 100 mA or 1A for the electro-sensitive and the thermal versions respectively. Figure 5 gives connector pin outs for these printers.

Finally, the pulse width required to print a dot is in the range of 0.24 to 0.48 ms for the electro-sensitive printer and 0.5 to 0.7 for the thermal printer. You can find the most suitable time by experiment — start with the shortest time and slowly increase it until you get a good print density, bearing in mind that the thermal elements can be burnt out, so a current limiting resistor might not be a bad idea — try something in the 15 to 40 ohms range.

The final printer in this series is the EUY 5E/5T which is an 80 character per line printer using 5in wide paper. This mechanism can print at two lines per second for the electro-sensitive type and 0.8 lines per second for the thermal type. Also, as with the EUY 10E/10T printers, the maximum number of characters per line can be factory preset by changing an internal timing wheel. These printers require a supply of 24 V, the motor draws 100 mA and the printing heads draw 100 mA per dot and 1 A per dot respectively for the electro-sensitive and the thermal types.

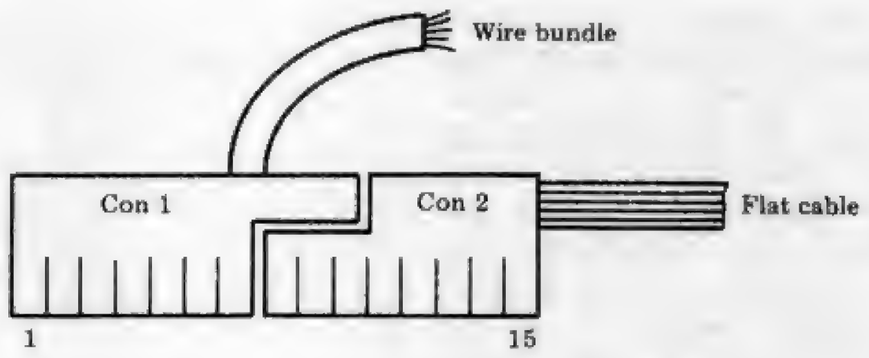
The photo detector LED requires a supply of 5 V at 30 mA. The pulse width required to print a dot is similar to that required by the EUY 10E/10T series and it should be adjusted in the same fashion to give a good print density. With the thermal heads you should attempt to keep the pulse width as small as possible, consistent with a legible print, in order to limit power dissipation in the thermal element and increase its useful life. The thermal element also incorporates a thermistor which could be used to control the pulse width applied to the

GOTO page 145



	Electrosensitive	Thermal
Con 1		
1	Reed switch	Reed switch
2	Clock pulse generator	Clock pulse generator
3	Reed/clock pulse common	Reed/clock pulse common
4	Motor + ve	Motor + ve
5	Motor — ve	Motor — ve
6	Paper roller (electrode common)	NC
7	NC	NC
Con 2		
8	Electrode 1 top	Element 1 top
9	Electrode 2	Element 2
10	Electrode 3	Element 3
11	Electrode 4	Element 4
12	Electrode 5	Element 5
13	Electrode 6	Element 6
14	Electrode 7 bottom	Element 7 bottom
15	NC	Element common
Con 3		
1	GND lug on printer frame	GND lug on printer frame

Fig 5 Connector pin-outs for EUY 10E/10T printers.



	Thermal	Electrosensitive
Con 1		
1	LED +ve	LED +ve
2	Phototrans +ve	Phototrans +ve
3	LED + phototrans —ve	LED + phototrans —ve
4	Motor +ve	Motor +ve
5	Motor —ve	Motor —ve
Con 2		
6	Thermistor +ve	Paper roller (electrode common)
7	Thermistor —ve	NC
8	Element 1 top	Electrode 1 top
9	Element 2	Electrode 2
10	Element 3	Electrode 3
11	Element 4	Electrode 4
12	Element 5	Electrode 5

Fig 6 Connector pin-outs for EUY 5E/5T printers.

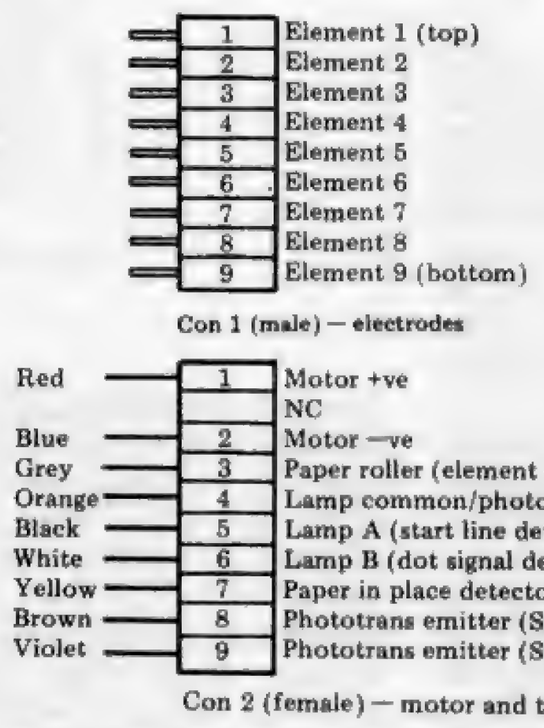
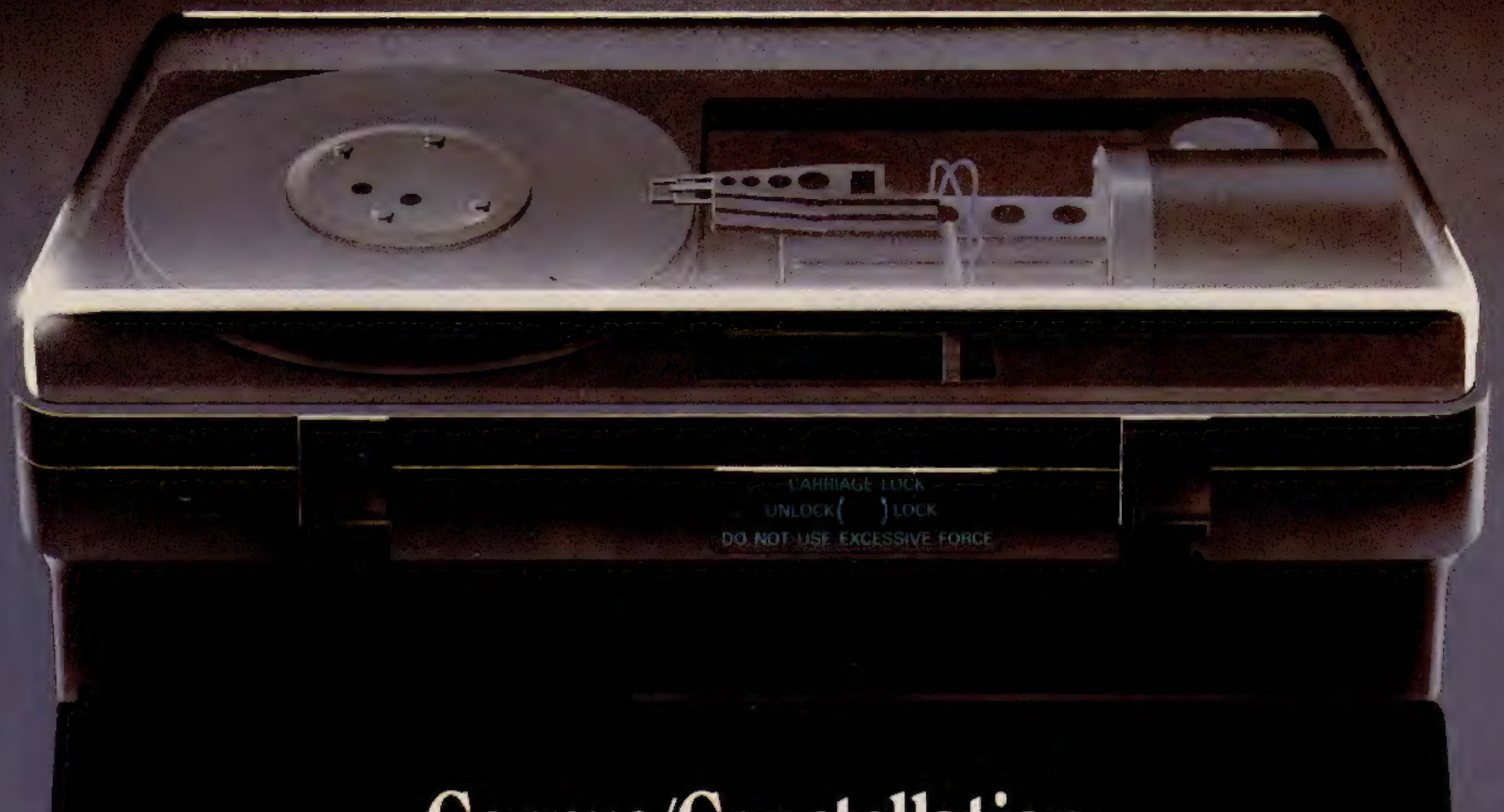


Fig 7 Pin-outs of DC4004A printer

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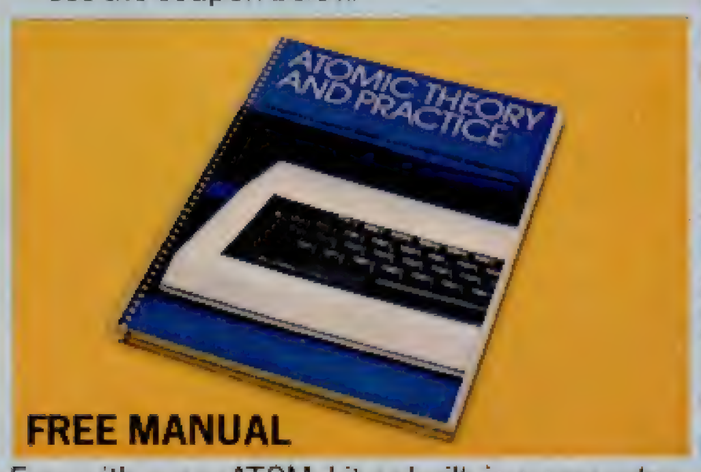


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COMPUTER GAMES

DRAW POKER

David Levy continues his examination of poker.

Last month we discussed the game of Stud Poker in a simplified, two-handed, form. We saw how it is possible to predict an opponent's hidden card from information gained during the betting and, from these predictions, we developed an algorithm for deciding whether or not to bet. This month we shall turn our attention to Draw Poker.

One major difference between last month's article and this is that, here, we shall consider a game for more than two players. Draw Poker for two would be extremely dull, and the ideal number is six or seven players. When writing your program I would suggest that you vary the number of players at your discretion. The principles that I am about to outline are applicable for any number of players.

The rules of the game

At the start of a hand, each player is dealt five cards face down, which he may look at. No-one else sees any of these cards. The player on the dealer's left usually opens the betting — there are various ways in which this is done; in some cases it is mandatory to bet, in other schools it is illegal to bet unless holding at least a pair of jacks. We shall assume that the first player may bet or check at will. (Incidentally, if you don't understand some of the terminology, obtain a copy of last month's *PCW* or, better still, place a subscription backdated to last month!)

The betting proceeds with each player having the option, when it is his turn to bet, of either dropping out of the pot ('passing' or 'folding') or putting in at least as much money as has been put in since he last bet ('calling' or 'raising'). When all of the active players have put the same amount of money into the pot, the first round of betting is over. The remaining players may then discard some of the cards in their hand and receive, in their place, an equal number of new cards from the unseen deck. This process, known as the draw, is conducted in a clockwise order starting on the dealer's left, so the dealer is the last player to draw new cards.

Once all the players have taken their turn to draw, a second round of betting takes place. When all remaining players have put the same amount of money into the pot, this second round is complete. The players all turn their cards over, and the one with the highest hand takes the pot. The order of importance of the hands is exactly the same as for five-card Stud (see last month's article).

The basis of the algorithm

At the start of a hand of Draw Poker, no-one *knows* anything about anyone else's cards, unlike Stud Poker in which at least one of the opponent's cards is visible from the outset. But by employing simple probabilities, it is possible to make certain estimates about the type of hand which a player is holding.

The probability of being dealt a straight flush is one in 64,974, or 0.0000153. The probability of being dealt the various other types of hand are shown in Table 1.

From this table we can determine the probability that an opponent has a certain type of holding after the cards are dealt, and it is an easy matter to work out the probability that the program holds better cards. For example, if the program holds a pair of Aces, the probability of a particular opponent having been dealt better cards is simply the sum of the probabilities of being dealt two pairs, three of a kind, straight, flush, full house, four of a kind and straight flush. If the program was dealt a full house — Aces and (say) twos— the probability that it was already beaten is the sum of the probabilities of the opponent being dealt four of a kind and a straight flush.

Thus, without any information gleaned from the betting or the other aspects of play, the program already knows something about the probability that it is winning at this stage of the game.

To employ such probabilities with any real degree of accuracy throughout the game, we must introduce a greater degree of discrimination than that achieved by dividing all possible hands into the nine categories listed above. I am indebted to my friend Stewart Reuben, one of Britain's leading poker players, for the division into 109 categories. This list (Table 2) should be coded into your poker program in such a way as to assign a two-byte probability estimate to each holding for each player in the game (apart from the program itself, which of course knows what it is holding).

A few comments are required on this division into 109 types of holding:

1) Hand number five — four cards to an inside straight or a straight open at only one end: in a situation with 4, 5, 6, 8, J, by discarding the Jack it is possible to draw one card which will make a straight, provided that card is a 7. Similarly, when holding 8, J, Q, K, A, by discarding the 8 and drawing a 10 it is possible to make the straight. In each of these situations there is only one card denomination which will suffice to make the straight, whereas with a holding such as 2, 6, 7, 8, 9, it would be possible to discard the 2 and make a straight by drawing *either* a 5 or a 10. We must therefore distinguish between a situation in which either of two cards will bring joy to our hearts. The reason for this distinction is obvious — it is twice as easy to make a straight when any one of 8 cards will work, as it is when any one of four cards will do.
2) There are more Ace high flushes than there are flushes with any other card high (think about if if you don't believe me). So to have an Ace high flush in the making is much better than to have a chance of making just any old flush. Hence the distinction between hands 7 and 8.
3) When holding three kings it is useful

Four of a kind:	one in 4165 or 0.00024
Full House:	one in 694, or 0.00144
Flush:	one in 509, or 0.00196
Straight:	one in 255, or 0.00392
Three of a kind:	one in 47, or 0.02128
Two Pairs:	one in 21, or 0.04762
One Pair:	one in 2.37, or 0.42194
No pair (high card only):	one in 1.99, or 0.50251

Table 1 Probability of being dealt certain poker hands

Numerical designation of the various possible holdings in five cards:

No hand	1
Three cards to a flush	2
Three cards to a straight flush	3
Ace high	4
Four cards to a straight flush missing inside card or open only at one end (ie, only cards of one denomination will make the straight)	5
Four cards to an open ended straight	6
Four cards to a flush without an Ace	7
Four cards to a flush with an Ace	8
Four cards to a straight flush missing inside card	9
Four cards to straight flush including Ace low	10
Four cards to straight flush including Ace high	11
Four cards to an open ended straight flush	12
Pair of 2s	13
Pair of 3s	14
Pair of 4s	15
.... etc	
Pair of Aces	25
Two Pairs 3s and 2s	26
Two Pairs, 4s high	27
Two Pairs, 5s high	28
... etc.	
Two Pairs, Aces high	37
Three 2s	38
Three 3s	39
Three 4s	40
... etc	
Three Kings with an Ace	50
Three Aces	51
Straight (A, 2, 3, 4, 5)	52
Straight (2, 3, 4, 5, 6)	53
Straight (3, 4, 5, 6, 7)	54
.... etc	
Straight (10, J, Q, K, 1)	61
Flush (7 high)	62
Flush (8 high)	63
Flush (9 high)	64
.... etc	
Flush (Ace high)	69
Flush (Ace, Q high)	70
Flush (Ace, K high)	71
Full House (2s)	72
Full House (3s)	73
Full House (4s)	74
.... etc	
Full House (Ks)	83
Full House (Ks over A)	84
Full House (Aces)	85
Four 2s	86
Four 3s	87
Four 4s	88
... etc	
Four Ks with an Ace	98
Four Aces	99
Straight Flush 4 high	100
Straight Flush 6 high	101
Straight Flush 7 high	102
... etc	
Straight Flush A high	109

Table 2 The 109 types of hand

to have an Ace as one of the two remaining cards, as this substantially reduces the chance of an opponent having or drawing three aces. This explains the distinction between holdings 49 and 40, and for a similar reason we must distinguish between holdings 83 and 84, since it is very useful when holding a full house of Kings to know that one of the Aces is already denied your opponent, who therefore has much less chance of holding or drawing a full house of Aces. Similarly, the distinction between hands 98 and 99.

Since we know the probability of a particular opponent being dealt a particular type of hand, we can calculate the probability of his holding any of the above 109 hands after the cards are first dealt. To do this accurately we would need to calculate exactly how many hands exist of each of the 109 types, and then divide this number by 2598960, which is the total number of possible hands in a 52 card deck with no wild cards.

The approximation that we shall use in this article is based on taking the probability of being dealt a particular category of hand (see table 1) and then dividing this by the number of types of hand within this category. Special calculations may be made for designations 1-12, but I doubt that this would improve the performance of the program, as any player holding a hand worse than 13 after the draw would (or should) certainly fold.

The probability of being dealt one pair is 0.42194. Since there are 13 possible pairs that one can have, the probability of being dealt a pair of 2s is 0.42194 x 1/13, or 0.0325.

The probability of being dealt a pair of 3s or a pair of anything else is also 0.0325, so we can assign to holdings 13 through 24 initial probability values of 0.0325. Up to now we have not used any approximation.

The probability of being dealt two pairs is 0.04762, but this total probability is not evenly split between two pairs (3 high), two pairs (4 high), . . . , two pairs (Ace high), because while there is only one way that a player can have two pairs 3s high (ie, two 3s and two 2s), there are two ways that he can have two pairs 3s high (ie, two 3s and two 3s, or two 4s and two 2s). It is easy to see that if you do not wish to follow my approximation, you can assign accurate probability estimates to holdings 26 through 37 by dividing the total probability of 0.04762 in the ratio 1:2:3:4:5: . . . :12. Alternatively, you can start with equal probability estimates for each type of hand, making all of them 0.04762 x 1/12, or 0.00397.

When this process has been completed, your program will have probability estimates for each of the 109 designations, these probabilities representing the likelihood that a player will be dealt a hand of this type in his first five cards.

These probabilities form the basis of our Draw Poker algorithm.

How the algorithm operates

Let us assume at the outset that there is no bluffing in our game. We can therefore deduce that when a player bets or raises he is indicating a strong hand, relative to some arbitrary point, and that if he checks or calls he is indicating a weak hand relative to that arbitrary point. As the betting proceeds, during the first round, players are repeatedly faced with a situation in which they must either fold, or put in more money *knowing that other players have bet or raised.* This point is very useful— a player who puts in money knowing that other players have indicated strength, must himself be indicating more strength than he would be indicating if no-one else had yet bet. In other words, the arbitrary point has moved upwards. A player who raises during the betting when there have already been ten raises before him, must have a fairly strong hand: after all, the other players are raising each other, and with each raise there is an implicit 'I think that my cards are better than yours.' So, to be in the pot after a number of raises requires a strong hand.

When the cards are dealt, each player will have, on average, a hand whose designation lies somewhere just below 13. This is known from table 1, which indicates that there is a slightly less than 50 percent chance of being dealt a pair or better. So at the start of each hand the program should assign to each of his opponent's designation lists, a pointer which is set on 12 or 13 (12 if you want the program to be slightly optimistic, 13 if you wish it to be slightly conservative). As each player puts in money, the program should adjust the position of that player's pointer, to indicate what it thinks the player's *minimum* holding is. This process can be accomplished in the following way, though the reader may find it preferable to vary the size of jump made by the pointer, in accordance with how his program reacts.

When a player checks his pointer is not moved. If he calls or raises however, his pointer is moved up by: 5 percent x (number of designations between present and 109) x number of raises where number of raises indicates how many players have raised the pot since this particular player last put in money. If he himself is raising, this raise is included in the number of raises.

The following example should explain how the method works. We assume that there are five players, called A, B, C, D and E. Each of them has his pointer set initially at 12. A is the first to speak, since the player on his right (E) dealt.

A checks, pointer remains at 12;
B bets, pointer moves up by 5% x (109-12) x 1 = 4.85, to 17 (rounded);
C raises, pointer moves up by 5% x (109 -12) x 2 = 9.7, to 22 (rounded);
D calls, pointer moves up by 5% x (109 -12) x 2 = 9.7, to 22 (rounded);
E raises, pointer moves up by 5% x (109-12) x 3 = 14.55, to 27 (rounded);
A calls, pointer moves up by 5% x (109-12) x 3 = 14.55, to 27 (rounded);
B raises, pointer moves up by 5% x (109-17) x 3 = 13.8, to 31 (rounded);
C calls, pointer moves up by 5% x (109 -22) x 2 = 8.7, to 31 (rounded);
D calls, pointer moves up by 5% x (109-22) x 2 = 8.7, to 31 (rounded);
E calls, pointer moves up to 5% x (109-27) x 1 = 4.1, to 31 (rounded);
A calls, pointer moves up to 5% x (109-27) x 1 = 4.1, to 31 (rounded).

Since the last four players have all called, the first round of betting is now at an end. The program has set the pointer for each of the players at 31, indicating that it expects each of them to have not less than two pairs, 8s high.

The next stage is to adjust the probabilities for all the hands of designation 31 through 109, so that they add up to one. The ratio of these probabilities is already known, it is simply the ratio of the initial probabilities as calculated from table 1 by dividing

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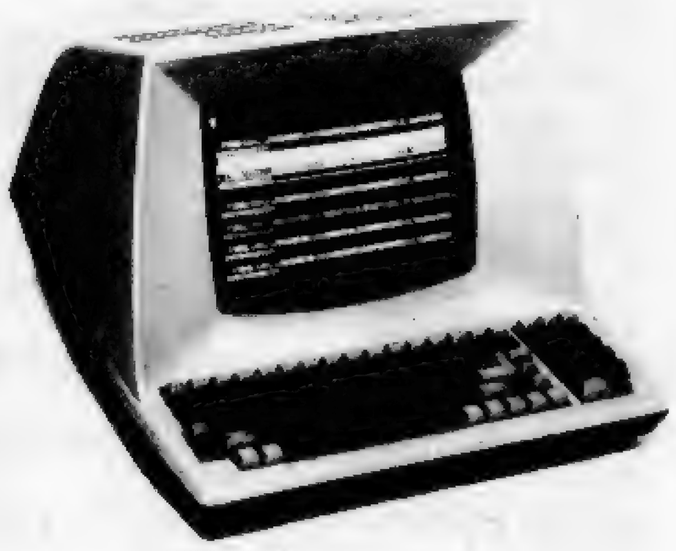
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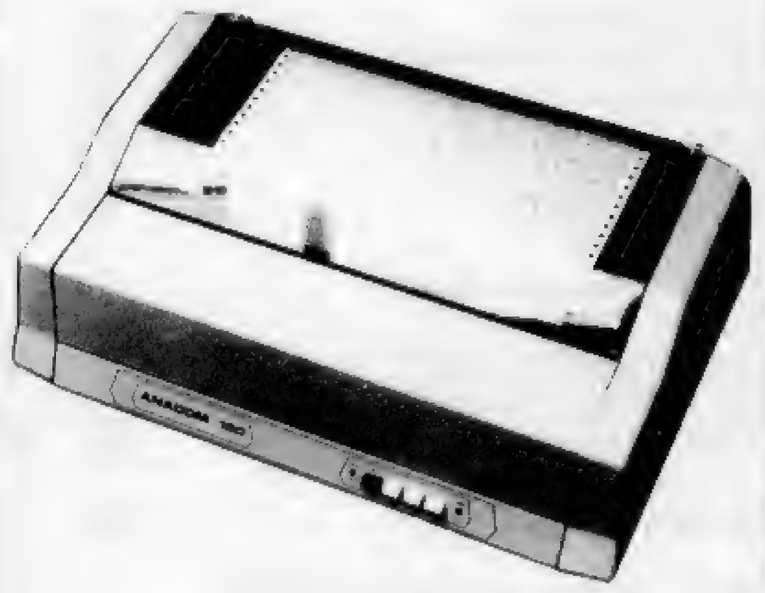
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categories of hands into the 109 types of hand. The program merely adds up all the probabilities for hand designations 31 through 109, and then divides each of them by the total, to arrive at a new measure for each. This new measure will keep the probabilities in the same ratio as before, while ensuring that their sum is 1.

In fact this adjustment can be made during the betting process. As a player bets, calls or raises, his pointer is adjusted and the probability measures can also be adjusted in the manner described in the preceding paragraph. The program may then make its betting decisions based on up to date information about the estimated strength of each of its opponents' hands.

What happens during the draw

The program, if it is still in the pot after the first round of betting, must then make a decision as to how many cards to throw away in the hope of drawing a better hand. This decision is often obvious and unambiguous, for example holding four cards to a straight or a flush and a completely disconnected card, it will always throw the disconnected card and hope to make a straight or flush. On the other hand, when holding three of a kind, many players prefer to discard one card rather than two, since the reduced chance of making four of a kind is partly compensated for by the fact that a single discard disguises your hand (you might have four cards to a straight, four to a flush, four to a straight flush, or two pairs). Your program should have a set of rules telling it what to discard according to what designation holding it has. Where there is a choice of discard, it should choose at random between two possible discards to disguise its play and confuse the opposition.

A certain amount can be learned from the number of cards discarded by the opponent, and I would suggest adjusting the probabilities for players who discard certain numbers of cards. For example, a player discarding three cards must be assumed to be holding a pair. Make the probabilities for all other holdings zero, and adjust the pair probabilities so that they add up to one.

A player discarding one card can be assumed not to have a pair, so set all of his pair probabilities to zero and adjust the other probabilities accordingly. (If his pointer is already at 26 or higher you need take no action, since it is already assumed that he does not hold less than two pairs.)

A player who discards four or five cards (five is prohibited in some schools) should be assumed to have designation 4 (if he discards four cards — assume that he has kept an Ace), or designation 1 (if he discards five cards).

A player who stands pat, ie, takes no cards at all, should be assumed to have at least designation 52, though when bluffing is added to your program you should allow for the 'no card bluff' in a certain proportion of hands, and assume a lower minimum designation.

Estimating how hands improve during the draw

All good books on poker give tables to show the odds against making various types of improvement to your hand during the draw. For example, Irwin Steig's *'Poker for Fun and Profit'*, teaches that when holding a pair and discarding three cards, the probability of making a full house is 0.0102, of making four of a kind 0.00278, of making three of a kind 0.1149, and of making two pairs 0.1587. We can use this information to adjust the probabilities still further.

Let us assume that, after the first round of betting, the pointers are all on 24 (a pair of kings). A player discards three cards, so we assume that he does indeed have a pair, and the designation probabilities are adjusted accordingly. We must then assume, after the draw, that the probabilities of his holding four of a kind, a full house, three of a kind and two pairs, are given by the above figures, and that the balance (0.7143) is the probability of his holding a pair after the draw. Having determined the probabilities for each of the feasible categories of hand, we can divide them up to indicate the probability of his holding each of the feasible types of hand (remember that some types, such as straights and flushes, are no longer feasible after the three card draw).

After the draw is over

The program now has at its disposal an updated list of probabilities and a pointer — all this for each player. The second round of betting now ensues and the pointers are adjusted as before, according to whether the player checks, bets, raises or calls. As the pointers move up and the probabilities are adjusted, so the program forms a changing picture of how its own hand compares to those of its opponents. If the program holds two pairs and there are four other players in the pot, all raising each other, the program will soon conclude that it is very probably beaten, and will fold. On the other hand, with a good full house, and only one other player raising, the program has more reason to be optimistic about its chances. How can this optimism be made into a betting strategy?

The program decides whether or not to remain in the pot in a similar manner to the method employed in Stud Poker. It calculates the probability that it holds the best cards, and compares this with the 'pot odds', the ratio of the amount of money that it must put in the pot: the amount of money already in the pot. If the odds against winning are less than the money odds, the program should play. If the odds against winning are greater than the money odds, it should fold. To determine the odds against it winning, the program first identifies the designation of its own hand. It then adds up, for each player, the probabilities corresponding to all the hands of higher designation. This gives the probability that this particular player has a better hand than the program. If the probability that player A has better cards than the program is PA, then the probability that the program has better cards than player A is (1-PA). The probability that the program holds the best hand of all is therefore:
(1-PA) x (1-PB) x (1-PC) x . . . etc.

Bluffing

If nobody bluffed in poker, the game would immediately lose its appeal. A program could play super-accurate poker because it could calculate the odds much quicker and more accurately than its human adversaries. But bluff is an essential element of the game.

Your program may determine when to bluff by making a decision that it will do so in a certain proportion of situations in which its opponents all appear to have weakish hands, and the program has already shown strength by its first round betting and by drawing a small number of cards (two or less). What this proportion should be is very much up to the reader, and depends on what style of game he wishes his program to play. I would suggest that your program only bluffs when all of its opponents have a less than 0.1 chance of holding three of a kind or greater. Even 0.1 may be a little on the high side for a game with seven players (six plus the program), but it can be made a variable to be set at the user's discretion at the start of play.

An important part of the program will be a routine to estimate the proportion or occasions when the opponent is bluffing. This can only be done by examining the opponent's cards when the showdown takes place ie, all the money is in the pot and everyone turns over their cards). At this point the program can make certain deductions about whether the opponent may have over-represented his hand during the betting. For example, if a player turns out to have only a pair of 6s at the end of a hand, but has been betting in such a way as to make the program think that he had at least three of a kind, then either the player is very bad, or he has been bluffing. In either case we should allow the program to reduce the value that it places on information gained from that player's betting habits.

The program should keep track of the betting, and remember how each player bet until the hand is over. If the player turns out to have a worse hand than the program believed possible, the program should analyse how the player's pointer was adjusted, and count how many times the player bet, called or raised after this stage was reached. This number of 'illicit' bets will be called BADBETS, and the total number of bets made by a player during a hand will be called ALLBETS. For every hand that is played out to a stage where the program sees the player's cards, BADBETS and ALLBETS are counted

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THE LAST ONE

A casual phone conversation in early November sent David Tebbutt scurrying off to deepest Somerset where he discovered a program which could just become the last one ever written by a human being.

While the rest of the world has been developing a series of ever higher level languages, two men in Somerset, David James and Scotty Bambury, have quietly created a system which actually removes the need for program coding. Suddenly, programming languages seem a little irrelevant since this system will chomp out bug-free programs on receipt of a program design. Of course, in order that people understand the programs produced, they are listed in Basic, although there is no real reason why they shouldn't be produced in machine code, Cobol, Pascal, or whatever else takes your fancy.

The system not only produces bug-free code but it also does it jolly quickly — a matter of a few minutes once the design details have been keyed in. Since it keeps a record of the program design, this can be modified at any time and new programs generated on the spot. This means that, for the first time in his life, the user can change his mind or modify his system without it costing him an arm and a leg. For the first time, too, ordinary people can implement their ideas on a computer without having to worry about expensive 'experts' or the rigours of learning to program. Programmers on the other hand should find their jobs enriched, getting their intellectual satisfaction from program design and avoiding the tedium of coding and debugging.

This British system, christened 'The Last One'* has the potential to make the frustration and delays usually associated with software production things of the past.

It will, of course, challenge existing ideas and attitudes and, I suppose, the data processing industry could be about to receive a small dose of the medicine it has been dishing out to users for years. In other words, those in the DP industry who fail to adapt to the new approach may find themselves out of work. I believe, though, that this system, if made widely available, will lead to a massive expansion of the marketplace resulting in opportunities that will more than make up for any program coding jobs which may disappear.

The product

David James has created what I believe to be a unique product. Most people would describe The Last One as a program generator, but not in the limited sense of RPG, FILETAB or even PEARL. This system is fairly easy to learn and use and is totally free from acronyms, abbreviations and codes. All input to the system is in plain English; only the results are coded.

Figure 1 shows an outline structure of The Last One. At the highest level of operation, the user is invited to input broad design details — a note of the aims and objectives of the system, the number of files required and the number of programs in the suite. Anyone taking this 'system' option will then be led through a series of questions relating to the files and the programs and, on completion of the questioning, appropriate program code will be generated by The Last One. For those who prefer to build up their system at the keyboard, they can ignore the 'system' option and simply select other options as they need them. The 'create file' and 'create program' options are self-explanatory, while 'modify file' and 'modify program' mean just that — it is possible to amend any program or file details at any time. All necessary changes throughout the system will be taken care of automatically. The 'enquiry' option allows the user to interrogate the system in a number of ways. It is possible to look at file details — both layout and contents — and it is possible to study program details as well. For those who may be feeling a little lost within The Last One itself, there is a 'help' option which offers a guided tour to the various operations available.

'Nobody told us it couldn't be done so we went ahead and did it'

'Scotty' Bambury

File creation involves setting up the necessary descriptive information such as file size, name, password, number of fields per record plus the definition of things such as field names, sizes and type of contents. All pretty straightforward stuff — nothing very unfamiliar there.

Program creation is a little different. Having created the file definitions, and this must always be done first as with many conventional computer languages, the user is then invited to enter program design details. This is done in a way very similar to the way many programmers work, especially those who say 'I never use flowcharts'. Although called the flowchart entry part of the system, the layout is more like that piece of paper on which you jot down your first thoughts about a program. All the likely options are presented in menu form offering choices like 'Input from console' or 'set index to end of file' or 'unconditional branch to ...'. In this way, a program design is created with typical actions being provided for input, output and processing. One other facility within this flowchart section is to allow the user to name other programs which have already been defined. These are then built into the coding for the program being created.

A 'flowchart' might look something like the example in Figure 2. Here we're opening two files — file 1 will have a field updated and file 2 will have transaction records added to it. Searching through the first file requires the index to be set to the start of file prior to each search. The user is required to input certain details through the console. In this example, we're assuming that each entry corresponds to a field in one of the files, the transaction file, therefore the labels can be 'borrowed' from this file and used as prompts on the screen. There are other ways of issuing prompts within The Last One if this isn't to your liking. The record in file 1 is accessed using a key, customer number perhaps, entered by the user. Calculations are performed — quantity times value and VAT calculation, perhaps. Then both files are updated. The cycle can be repeated until the user replies 'no' to the 'again' question, then the end of file is written to file 2 and the program terminated, usually by a call to another program.

Now, it's very clear from the above that there's a lot more to program writing than just putting in simple flowcharts like that. The point about The Last One is that once you've given it a structure to work to, it can then ask all the necessary questions to fill in the gaps in its information. It will be asking for details of the fields to be entered through the console, where to jump to, what key fields will be used to search the file and precisely what maths is involved.

Once the answers to these questions have been given, The Last One then gets on with generating program code. It produces two versions of each program — one following the precise structure laid down by the program designer, the other using its own knowledge of program structuring to optimise the code. It then benchtests each one, compares the results and churns the best one on to disk (or tape). Since *PCW*'s visits, work has been done on a version which will give the user the option of choosing between speed and memory efficiency.

'..should be supported for ... its national importance'

Barclays Bank investigator

Program generation takes just a few minutes once the design details have been keyed into The Last One. Most of the programs I saw generated took around five or six minutes and they were absolutely bug free — a significant improvement over any programmer. Admittedly, the programs weren't vast — usually between 100 and 200 lines, but then The Last One is at present written in Basic so things could be hotted up phenomenally by the use of machine code. It's a funny thing, but

** Trade Mark applied for*

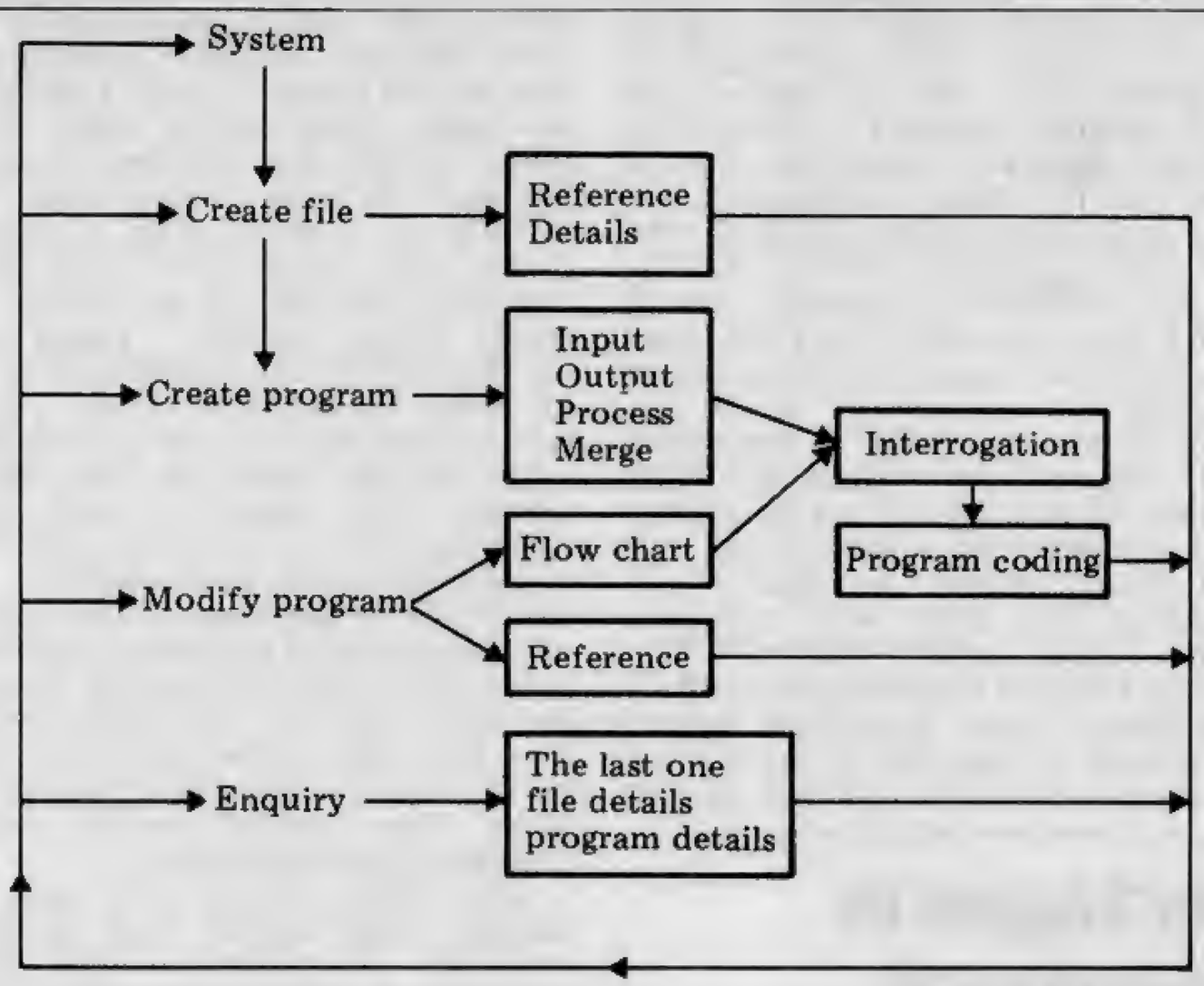


Fig 1 Outline structure of The Last One

```
1   Open files 1 — 2
2   Jump to end of file 2
3   Set Index to start of file 1
4   Console input using labels from file 2
5   Ask user 'Is this data correct'. If no jump
6   Search file 1 for data
7   Maths with files 1—2
8   Write to files 1—2
9   Ask user 'again'. If yes jump
10  Write 'end' to appended file number 2
11  Terminate program
```

Fig 2 A simple 'flowchart'

once you get used to programs being generated in six minutes you forget how amazing it is and start to get impatient!

The program can now be tested and the results analysed using the enquiry facility to look at the contents of files. If it doesn't work properly then it would be because of a logic fault somewhere in the design of your program or system. File design or program design can easily be modified and one of the nicest things about the whole system is that if a file layout is changed in any way, then all the programs affected by this change are themselves modified and regenerated. If a program is modified, the system will ask those questions necessary to complete its new design and then generate fresh code.

The design of The Last One allows it to be run on almost any computer from an HP 41C to, presumably, the biggest Cray. David does all his development work on an Ohio C3C with 96k memory, two terminals, a 23Mb hard Winchester disk — shortly to be upgraded to 74Mb — and twin 8in floppies for security purposes. He has had versions of The Last One running on Apple, Tandy, PET, Wang 2200, Sorcerer, HP 41C — 'admittedly a somewhat cut down version' said David — and one or two other machines to boot. At the moment, he is concentrating his efforts on getting the system running on a PET both disk- and tape-based, and under CP/M. Within a matter of months the current version of the system should be available for all the popular machines. Of course, cassette and floppy based systems won't run quite as quickly as the Ohio system but even then, the speed will be many many times faster than hand coding.

'A lot of effort should be put into exporting it and showing the rest of the world that British can still be best'

Report from *PCW* to the DOI

Future developments of The Last One will make it more accessible to the user by removing the need to create program designs. Eventually, it is hoped that a user may simply be questioned about his needs and, once the system has a complete and logical picture of the requirements, it will itself define the files and design the programs. This is a little way way off because of the need to adapt it to run on the popular machines. There is also some talk about producing different versions of The Last One to suit the different types of user. For example, there may be an architect's version, one for the scientist, another for computer games, and so on.

THE LAST ONE

Who it's for

At the moment The Last One is clearly aimed at the system designer and the analyst/programmer. That's not to say that others won't use it, they most certainly will, it's just that that particular market can pick up the product and use it profitably within a couple of hours. Others less used to a structured approach to systems analysis and design will have to discipline their working methods a little — surely no bad thing. It will probably result in sounder systems designs anyway.

'If the computer is to be truly `personal', adult and child users must be able to get it to perform useful activities without resorting to the services of an expert'

Robert M Gravina, Associate Professor of Mathematics, University of Lowell, Massachusetts.

One of the things which David and Scotty feel strongly about is documentation — David because he hates doing it and Scotty because he knows it's vital to the product's success. Accordingly, they plan two books, both of which will probably be written by an outsider who can make a first class job of them. Inevitably, the first book is an operating manual aimed at the experienced person and outlining the structure of The Last One and the options available at the various stages. This book will also contain a number of worked examples which will be particularly useful during the early stages of ownership. The other book will be an altogether grander affair which will be aimed at the inexperienced user — inexperienced in systems analysis and design, that is. This book will take such a person through all the stages necessary to take him from knowing nothing to being able to construct systems using The Last One. This book would almost certainly have much value in its own right, too, if readers ignore the fact that the final part will relate specifically to The Last One.

'It'll make computers available to many many more people'

'Scotty' Bambury

While no firm marketing decisions have yet been taken, it is looking almost certain that the product will be made available all over the world and will be marketed like any other standard package. There is some talk of registering

users, thus entitling them to buy upgrades to the system as they become available, but no decision has been taken yet.

I am certain that when existing software houses see the product they will want to use it for their own systems development work. It will give them a measure of control over the programming function, previously such a difficult aspect to manage. The Last One is likely to result in a change of emphasis rather than in any revolution within the computer industry. Users who take the trouble to learn about The Last One will be able to implement their ideas without employing expensive experts. The likely consequence of this is that users will have a stab at computerising things that they would not have dreamt of previously. It won't matter if they make mistakes because it's no longer a time consuming and costly business to modify or rewrite the programs. If users know that The Last One exists and that they have a fair chance of being able to use it successfully, then they are more likely to take the plunge and buy themselves a computer. This will result in a tremendous market expansion — something that can't really happen without The Last One or something similar appearing on the scene.

If there is such a person as a program coder, and I have heard of *one*, then he is going to have to change his job — perhaps running The Last One on behalf of the analysts? The analyst/programmer should welcome this development because it means that he can spend more time on ideas and less on tedious coding and debugging. System designers should be overjoyed because it means they can implement their ideas in the way they want to without necessarily having to use the services of a programmer. One thing is certain: things are going to change, but the market expansion brought about by systems such as this will surely improve the employment prospects for data processing professionals rather than diminish them.

'Manpower shortages in England will require at least 500 new programmers per month until 1985 to keep pace with user demand'

David Butler at the Infotech 'State of the Art' review, 1980

Background

The two principals in this story are somewhat unusual and it will help you understand how The Last One came into being if I explain. First of all, David James left school, Millfield, with just one 'O' level, in history, he thinks. Realising that this really wasn't quite good enough, he went back to school to take another two — maths and physics. Thus armed, he set off to see the world, ending up doing various strange jobs — such as being a film extra in Jamaica and helping out on a sheep farm in Australia. While working in an Australian steel mill, he learned that he'd inherited around £1 million from a family trust and, having been 'on the road' for five years, he figured it was time to go home and do something with this rather handsome windfall. He duly set up a number of companies, one of which had a job which was pretty hard to control by manual methods. David decided that a computer would probably help so he bought a Wang 2200 and went off on a three day Basic course. Whether he ever got his application computerised I don't know, but one thing's certain: he entered into almost a love affair with computers which literally nearly destroyed him.

David started developing an artificial intelligence system seven years ago and he became so engrossed in this that his businesses gradually collapsed around him, leaving him bankrupt. All his computers — the Wang, an Apple, a Tandy and a PET — were taken away from him and, because of his previous wealth, he was pestered by television and newspaper reporters. Things got so bad for him that he tried to kill himself. He was rushed to hospital where he recovered, his mum bought him a Sorcerer and, once again, he was doing what he loved — working with the computer. He was still feeling desperately low when an article appeared in *Computer Talk* describing his rise and fall and mentioning the artificial intelligence system he was working on.

Before continuing with David's story I should introduce you to the other principal in this saga — 'Scotty' Bambury. Like David he'd left grammar school with a couple of 'O' levels and he'd also spent five of his early years 'bumming around', in his case on and around the Watford by-pass. Scotty was a motorbike freak and used to spend most of his time mending bikes at the roadside or performing daft stunts like driving up the by-pass embankment then hurtling across the road without actually touching it! One day he bought a car — a bit of an old banger, really, but he sold it for a profit the next day. This led him on to buying more cars, tuning them and reselling at a profit using a council-owned grass verge as his showroom! Inevitably, this came to an end and the family decided to find 'a garage on a hill somewhere'. The 'somewhere' ended up being Yarcombe in Devon. Scotty and his dad sunk all the money they could get their hands on into Hilltop Garage. They moved in with their respective wives only to find they had an immediate cash flow problem — no money for housekeeping! Scotty dashed out and persuaded someone to lend him some tyres which he promptly flogged. He went back to this same person, gave him cash for the tyres and asked for some more. Thus began the international tyre business which Scotty now runs called Eurotyres.

Like David, Scotty felt that the business could benefit from having a computer. He bought a Data Saab something or other and let Data Saab's own people install the system. The day came when he wanted the software changed and he was quoted such ridiculous prices and lead times that he started to reflect on the possibility of doing the job himself. One of his early ideas was to use the power of the computer to generate programs in response to the user defining his requirements. In fact, the more he thought about it, the dafter the DP industry seemed to be, sitting on all that power and not using it to help with their own jobs. Two days after deciding to write his own system, he read about David's downfall in *Computer Talk*. He realised immediately that David had already gone through this loop some five years previously so they arranged to meet.

The meeting took place at the Eurotyres office and Scotty's suspicions were confirmed — David had indeed constructed some program writing routines in connection with his work on artificial intelligence. The two men hit it off together immediately and Scotty realised that he wouldn't have to learn to program after all — he could use David. Scotty formed a company immediately and took David under his wing, giving him computers, somewhere to work and, after a couple of months, somewhere to live as well. The company is now called DJ 'AI' Systems.

'One of Scotty's early ideas was to use the power of the computer to generate programs in response to the user defining his requirements'

For the last 18 months David has worked exclusively on The Last One with Scotty keeping his feet on the ground whenever he tried to so some airy fairy stuff which wasn't strictly

relevant to their objectives. David tells me that meeting Scotty was nothing short of a miracle. He is convinced that if they hadn't met, he would have taken another overdose but done it properly the second time. Instead, the pair of them have come up with a truly remarkable product which removes software as a barrier to widespread use of computers. For the first time, the user can have the system he wants, when he wants it and one which is easy to change along with his changing requirements.

'We didn't know that we'd done anything clever until PCW told us'

'Scotty' Bambury

Conclusion

Because David James and Scotty Bambury have no real connection with the data processing industry, they have succeeded in creating a product which is quite unique. No doubt you will recognise the odd technique borrowed from here and another bit which reminds you of something you already know. But the fact is that they produced The Last One in almost complete isolation, concentrating on satisfying the needs of the user of such a system, rather than by studying things like language development. So it is that a system has been produced which not only makes it easy to create operational computer programs quickly, but also allows the user to change his mind without causing serious problems. In the past, a user was expected to agree to a computer system design without having any real idea of what the end product would be like in practice. He had to wait several months for the work to be done only to find that the results weren't quite what he wanted after all. Now, if the end results aren't quite right, the system can be changed at the drop of a hat.

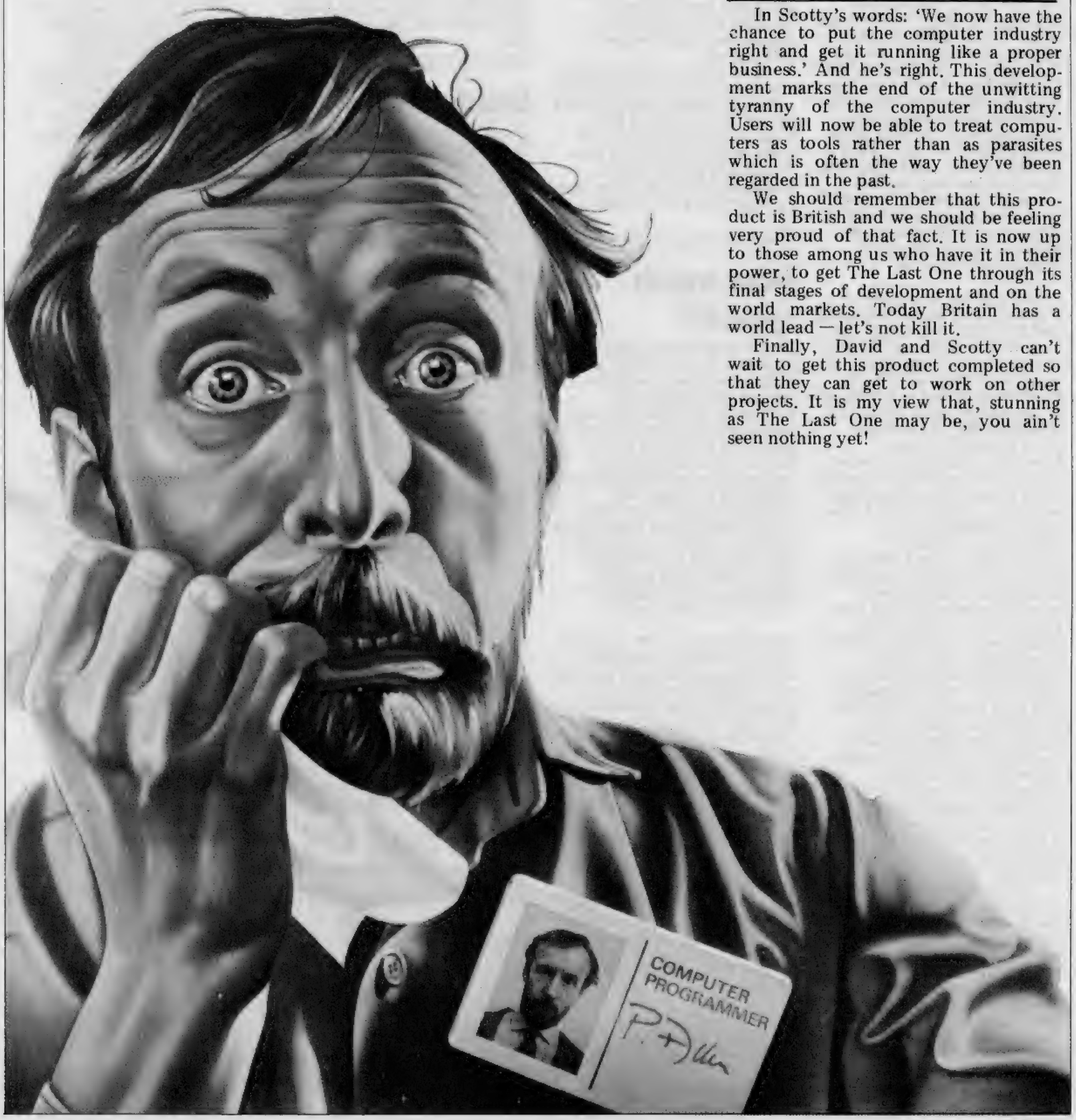
'You've found the philosopher's stone'

PCW's first reaction

In Scotty's words: 'We now have the chance to put the computer industry right and get it running like a proper business.' And he's right. This development marks the end of the unwitting tyranny of the computer industry. Users will now be able to treat computers as tools rather than as parasites which is often the way they've been regarded in the past.

We should remember that this product is British and we should be feeling very proud of that fact. It is now up to those among us who have it in their power, to get The Last One through its final stages of development and on the world markets. Today Britain has a world lead — let's not kill it.

Finally, David and Scotty can't wait to get this product completed so that they can get to work on other projects. It is my view that, stunning as The Last One may be, you ain't seen nothing yet!





COMPUTER ANSWERS

Send your queries to: Sheridan Williams, 35 St Julians Road, St Albans, Herts.

Adventurous builder

I am an electronics technician with the RN and have a good knowledge of digital techniques and logic. I am leaving the RN in a couple of years and would like to build and design my own micro so that I could experiment with the basic hardware and all levels of programming languages from machine code up. With the software in mind, what considerations must be given at the design stage to the eventual language to be used? Which language is Adventure written in, and how much memory does it require?
M McKenzie, Devon

I would think very hard before setting about designing and building your own micro. You will certainly not end up saving yourself any money by doing so. There will also be many points that you will miss in the design stage which will severely limit the uses for your eventual system. However, please don't let me put you off as there are many good reasons for embarking on such a project. One of the main considerations is whether you want to concentrate on the software side more than the hardware, because if you do, then I would recommend that you look at one of the many single-board systems currently available. Your letter emphasises that you wish to experiment with languages and so it would be advisable to think hard before too many irreversible decisions are made. A friend of mine has taken the course of designing and building his own and already it has taken him six months, several hours a week; added to that there are several points he would change if he could.

As far as languages are concerned, you will have to master machine code, but you can ease this if an assembler is available. I would opt for a system that supports Forth as this language has all the advantages of machine code, is compact, runs very fast but has high-level type instructions to speed program writing. Make sure that the system that you choose has a very good and comprehensive manual, as this will be of utmost importance to you.

Adventure source code is usually written in Fortran, and it was originally used on mainframe computers where 'main store' is unlimited compared to micros. For that reason, most versions call the file into main store and execute without recourse to files. This requires around 100k of main store (32 bits) as far as I can gather. There are many pruned-down versions now available on micros but most require a disk system.

Most areas of Britain have computer clubs, with around half their members interested in hardware; look in the User Groups Index in *PCW* and contact your local one — you will get far more useful advice from them than I can give in a brief reply.
SW

How much space?

I have been contemplating buying a Sinclair ZX80 to run programs already written. One of the programs is written in Fortran and solves simultaneous equations but I intend to transpose it into Basic. I also wish to play games and run programs for statistical analysis. My Fortran program uses large multi-dimensional arrays such as A(17, 18, 18) — how do I find out how much RAM space I will need for the program and the variable?
I R Cooke, Manchester

Deciding how much memory will be needed is certainly a common problem. I can tell you straight away that the present ZX80 is nowhere near the right machine for you. You will require around two bytes per integer and between four and eight bytes per floating point variable depending on the version of Basic being used. Your array requires around 8000 array elements and, at four bytes each, say, you will need 32k just for the array! There are a great many machines that have versions of Basic that support multi-dimension arrays (steer clear of old ROM PETs), take a trip to a local dealer and try running this program:

```
10 DIM A (17, 18, 18)
20 PRINT FRE (X)
```

which will either display 'OUT OF MEMORY' or print a value telling you how much memory is left.

In order to ascertain how much memory is required for the program you can obtain a rough answer by assigning two bytes for each line number, one byte per keyword, one byte per extra symbol, two bytes per integer constant, four to eight bytes per fp constant and n + 2 bytes for an n-char string. Look at machines like Tandy, Video Genie, Sharp MZ-80K but get your requirements firmly set out on paper before comparing systems.
SW

Inside the Atom

Would you please answer the following questions on the Acorn Atom?

1) **What is the access time of the 2114 static RAM chips?**
2) **What is the price of the 32k dynamic RAM board and the 8k static RAM board?**
3) **You say in your review that when the 32k RAM board is fitted, 9k is unseen. Is this only with a fully expanded machine?**
4) **What is necessary to output PAL colour signals, what is the resolution, choice of colours and the price?**
5) **Does the advertised power supply cover all versions ie 8 V at 800 mA to +5 V at 1.8 A?**
6) **Are the faults in the VDG (6847), ie 60 instead of 50 Hz and 32 x 16 display, easily upgradeable? I've heard of a 80 x 16 word processing card — would this aid the 60 Hz problem?**
7) **Could you state which of the following faults stated in your review have been corrected for production versions: video lead, faulty keyboard, engraved keys, cassette loading, index?**
8) **Could you state the graphics commands and tell me what they mean?**
9) **What is the NEW command for?**
10) **I work with a DEC 10 at school — could I use my programs on the Atom?**

Krste Asanovic, Corby & Craig Zanelli, Enfield

I would send off for the manual *Atomic Theory and Practice* which is available from Acorn. This is a very good manual for the Atom and one worth buying for £8. Its author, David Johnson-Davies of Acorn Computers, very kindly provided most of the answers to the questions above.

Here they are:

1) The RAM chips must have an access time of less than 500 ns;
2) The price of the 32k dynamic RAM board depends on the configuration but is around £195 to £205, excluding VAT. The 8k static RAM board costs £109 in kit form;
3) The 32k card can be fitted between addresses OH and 7FFFH and, of this, 400 upwards is usable for program text. Normally you would use 2900 upwards (the default configuration on switch-on) giving just under 22k of continuous space;
4) For colour you would need to fit an Atom PAL encoder board which costs £24.50 and plugs inside the Atom. There are two possible sets of four colours, selectable in software — green, yellow, blue, red and buff, cyan, magenta, orange;
5) The Atom power supply will power a fully expanded Atom, which requires 1.6 A at 8 V;
6) Acorn produces an 80 x 25 VDU which can be fitted inside the Atom case. Note that you will have to load a new VDU handler or have one in ROM;
7) Video lead is supplied with all Atoms. The keyboard seldom causes problems. All the keys are engraved. We do not get any complaints about cassette interface from Atom owners. The manual *does* include an index.
8) Graphics work with O, O at the bottom left-hand corner. CLEAR prepares screen for graphics in any one of nine modes. MOVE will move the graphics cursor. DRAW will plot a line anywhere on the screen from the cursor to the point specified. PLOT will plot a point anywhere on the screen.
9) The NEW command clears the memory of the current program. In fact it just moves the 'end of text' marker to the start of the text area. Programs may be recovered with 'OLD'
10) You will find considerable differences between DEC 10 Basic and other versions of Basic. This is a problem not confined to the Atom. Areas of major difference are the handling of strings and files. If you are a competent programmer, I can see no major problems for you,

but your programs are unlikely to be directly transferable.
SW

Agro for HP

My section has a Hewlett Packard 9830B computer or 'desk-top calculator' and there is no prospect of renewing the system. I desparately need to compile and run Fortran programs or, at a pinch, Basic, in order to speed up some of the data processing work we do. Is there a Fortran for the 9830?
L W Huson, Ministry of Agriculture, Surrey

Hewlett Packard tells me that none of its desk-top systems have Fortran. It's available on HP mini-computer systems and there is no chance of one being developed for the small machines.

I have thought about your problem and feel that the solution does not lie in a compiler of any sort. You see, for most data processing programs, the CPU is I/O bound; that means that however fast the CPU or compiler/interpreter works, it cannot work any faster than the rate at which data can be transferred between peripherals. This is a point often overlooked by those new to micros. Data processing usually involves a great deal of file handling and even if it doesn't, some of the work will be arithmetic, in which case all the floating point arithmetic is done at machine code speed anyway. The only chance of speeding up the program with a compiler is if the program does much of its processing using loops, in which a great deal of decision making is done. I have purposely oversimplified the whole task of data processing but, having tried compilers as a solution, I have not always been happy with the resulting increase in speed. I have often been able to make a similar improvements by redesigning my program and file structure/design. I expect that your problem would be solved with a direct access file but cannot tell without further details
SW

Whatsit mean?

I have a Tandy TRS-80, and want to type in the program 'Ski jump' on page 83 of the Nov issue. What is PRINT LIN/(2)? In fact, the / sign appears throughout the program. Can you also recommend a book which is full of TRS-80 programs?
H W Heppel, Lightwater, Surrey

The / sign is a replacement for the S sign, and the LIN/(n) function prints n blank lines; so replace line 70 with PRINT:PRINT. Yes, there is a book full of TRS-80 programs but I cannot recommend it because I haven't read it. It is called *32 Basic Programs for the TRS-80 (Level 2)* by Rugg & Feldman. It has 267 pages, and contains home/educational games, graphics mathematics and miscellaneous programs. There are at least nine other books with Basic programs in.
SW

New Roms for old

I own an 8k old ROM PET which I wish to upgrade to a new ROM version but cannot find any adverts offering this service. Can you tell me who provides this service?
C Petch, Leicester

Virtually any dealer of PETs worth his salt will undertake the upgrade. It is only a matter of replacing a chip. Just phone around the dealers closest to you.
SW

Novel problem

I am a novelist and write around two novels a year (under different names). I am now getting fed up with scissors-and-paste revisions and the endless retyping of whole paragraphs because one or two words have changed. What I need to be able to do is produce good quality copies for publishers and also insert, delete, transpose and substitute text from single letters to whole paragraphs. Ideally I'd like to be able to move words around using a light pen. I am restricted to the PET and Apple and would like your advice.
M Ross-MacDonald, Banagher, Co Offaly

There are several points to consider here but basically there is no problem. Both the Apple and PET have word processors but in my view the 'Wordcraft' for the PET is superior. The PET also has a far better keyboard with a shift lock. The keyboard will be an immensely important consideration and should not be taken too lightly. You should go for the new 80-column screen PET, as this will make text far easier to view. There are versions for both the Computhink disks from Petsoft and also the PET disks from Dataview in Colchester; your dealer should have no problem obtaining either. If he does, then buy the hardware from him and order the software from another supplier by post.

I estimate that an average novel contains 800,000 characters; as the 2040 PET disks hold 170,000 characters and the 8050 PET disks hold 500,000, you will be able to work out easily how you will have to process your books. Several disks will be needed in order to hold backup copies of text (don't ignore or underestimate the importance of at least two copies plus the original disks).
SW

Pinta cure

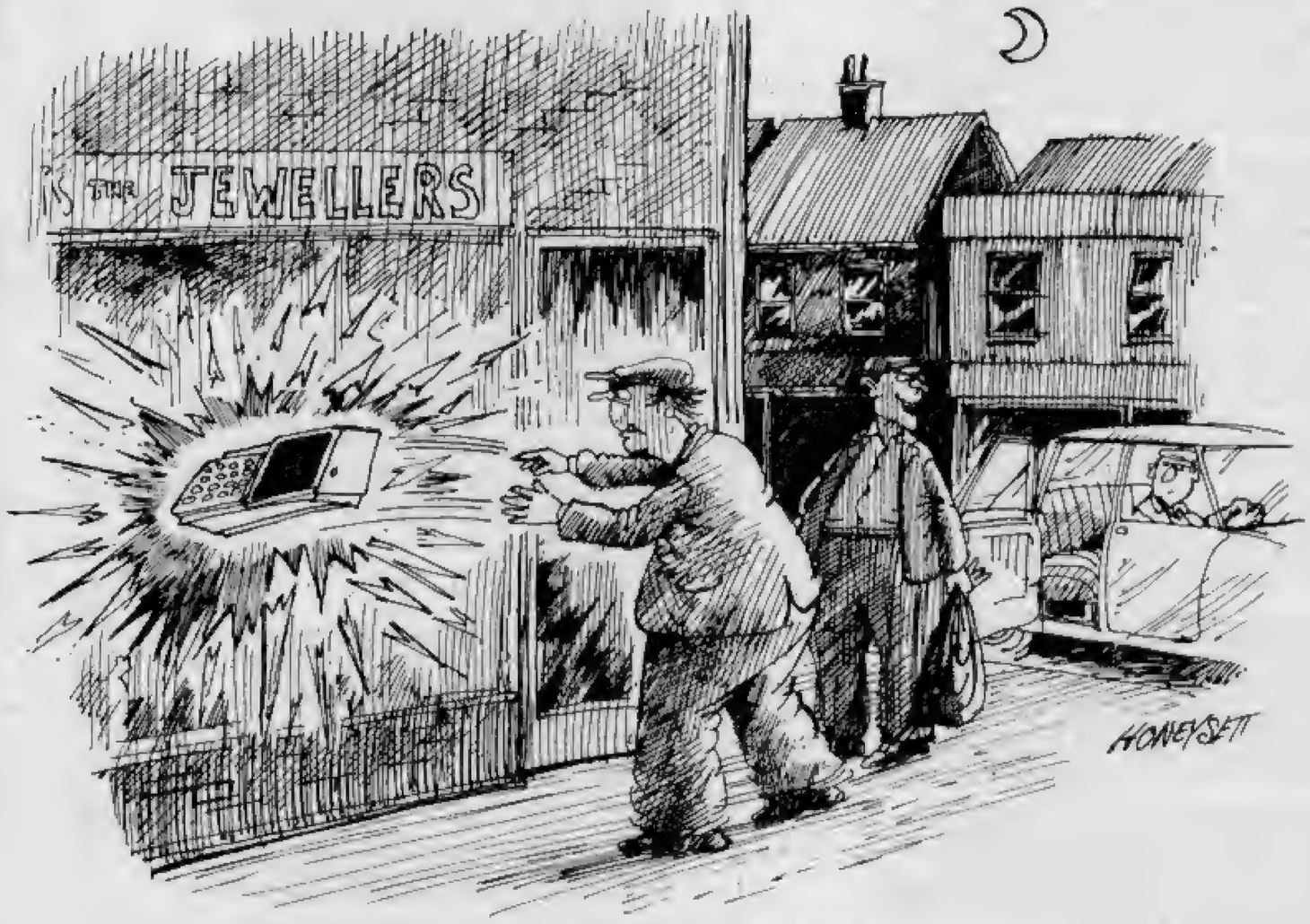
I have a Sinclair ZX80 and when I enter about 47 lines, the cursor and the line I am entering both move up to the last line entered before I have pressed NEWLINE. Why?
John McRae, Strathclyde

It appears that your ZX80 has a hardware fault which shows up when the machine overheats. ZX80s move in mysterious ways when they get hot. My own machine — before I moved the power supply away from the computer — often went into the SAVE mode when any key had been pressed after it had been running for a few hours. Try putting a frozen long-life milk carton on the ZX80, just to the left of the 'hump'. Absurd as this suggestion sounds, it is an easy, and non-technical (!) means of drawing heat away from the power supply. You may well find this stops your problem completely. Certainly my ZX80 no longer behaves oddly now that its heat is more adequately dissipated. If you're not into such extreme 'minimum technological support', you can rig up a big bolt, or tobacco can, as a heat sink.
Tim Hartnell, National ZX80 Users Club

Foreign TV standards

Is it possible to connect computers like the Sinclair ZX80, Acorn Atom and New Brain with TV sets in places like France, West Germany, Brazil and the USA? If not, what modifications should be needed in the UHF modulators and/or video interfaces?
E D Zanotto, Sheffield

The easiest thing would be to take your own portable set with you! Television sets vary considerably to match local transmission characteristics. These can vary quite widely as to the number of



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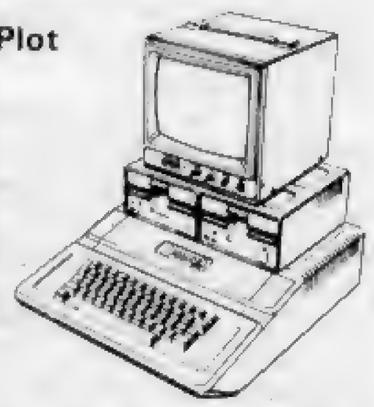
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lines, the supply frequency and the transmission band (VHF or UHF). This could certainly call for different modulators at the least.

In addition to the varying details mentioned above, at least three different colour transmission systems are in use — the French Secam, the German and British PAL and the US NTSC system — and there are often local variations on these. Brazil, for example, is one of several countries using a S25-line, 30 Hz fixed rate PAL system!

With all the variations in equipment listed, not to mention differing mains voltages, it would take a whole article, rather than the space here, to do justice to the modifications needed to adapt individual UHF modulators to each country. If you can't take your TV set with you, try buying the modulator in the country in question. Of course, you should have a demonstration that it will work with your computer before buying. Please also check that the local voltage will not damage your computer before you first plug it in.
P L McIlmoyle

Size diskussion

Could you advise on the pros and cons of full-size 8in floppy disks as compared with 5in mini-disks? I am thinking in terms of a typical 'small business' set-up, with two disk drives, costing in the region of £3000-£5000.
Name and address supplied

The 8in floppy disks have been around for quite a bit longer and have come to be accepted as standard in mainframe and minicomputer circles. In those quarters, mini-disks are regarded usually as 'amateur' or 'for home computers'. Despite this, one of the leading makes of commercial word-processors — AES — Wordplex — have moved from twin 8in drives to twin mini drives as standard on one of their leading models. In brief, the 8in disks have going for them:
— Older established and introduced by IBM;
— Potentially greater storage capacity per disk (about 250k single-sided, single density, 500k double density, 1 to 1.2 Megabytes double density, double-sided);
— Give a 'professional' image to the complete system.

The snags are:
— A history of reliability problems with double-sided drives, although this is generally believed to have been largely overcome by the latest designs;
— It is normal practice for 8in drives to rotate the whole time the system is switched on, rather than only when an access is made to them. This can lead to complaints of noise from office staff (though they are quiet compared to printers!) and shortens disk life.

Points in favour of the mini-disks are:
— The drives are small enough to build into VDU units;
— Reasonable storage capacity (up to about 320 kbytes in the double density, double-sided format);
— Established reliability even in the double-sided versions;
— Lower cost of the drives;
— Drives do not usually run continuously.

On the problem side, they have:
— Lower capacity;
— 'Toy computer' image.

Summing up, I have a suspicion that the 8in floppy disks will retreat before the onslaught of the 'Winchesters', while the mini-disks will gain greater acceptance in the commercial computing field, especially with the growth of 'distributed processing' and 'intelligent terminals'.
P L McIlmoyle

'Intelligent' ZX80

My ZX80 seems to think for itself. I was experimenting with a program to generate prime numbers and when LOADing it a day or two after first SAVEing it, I noticed a question mark in one line (LET S = 3? to TRIAL—1). Despite this, the program ran perfectly (was the ZX80 trying to help me?) but the question mark had vanished when I returned to the listing and there was no way I could get it back in. How come?
W Cartwright, Lostock, Bolton

It appears that you may have accidently POKEd a character code corresponding to a question mark into the listing. There is no way to directly enter a question mark in the position you found it without getting a syntax error. By the way, POKEing these particular characters into the ZX80, and subsequently listing the program, is a dangerous practice which is likely to play such havoc with your machine that you have to disconnect the power before you are able to use it again.
Tim Hartnell, National ZX80 Users Club

Coming soon?

I have heard that Clive Sinclair is developing a printer for the ZX80. If this is so, when will it be on the market, and how much will it cost?
R Whiteley, Leeds

Uncle Clive is indeed developing a printer and withdrew the new 8k ROM in late September, 1980, to reprogram part of it to drive a printer. He is somewhat unforthcoming about the cost and proposed delivery date but my reading between the lines suggests availability in May/June and a price of around £85. However, these are only semi-educated guesses.
Tim Hartnell, National ZX80 Users Club

Display wanted

Where can I get a multi-character dot matrix display, as used in the Newbury New-Brain, Sharp PC-1211, etc, and what would it cost?
N Smith Milton Keynes

Like many concerned with building prototype, one-off, or short-run electronic gear, my first reaction was to reach for that excellent catalogue produced by RS Components Ltd, (P O Box 427, 13-17 Epworth St, London EC2P 2HA). And there on page 109 of the latest (November) issue are devices which come close to being what you are looking for. Not quite, I'm afraid, as each unit is only one character wide and, as listed, displays only the hexadecimal characters of 0 through F, rather than the full range of alphanumeric characters, let alone the full ASCII set.

The first problem is easily overcome, by stacking them side-by-side (though, at £8.60 each, plus VAT, etc, you might not want to have too many!) The second problem is less simple, as it would mean by-passing the built-in decoder and display driver, to use your own control of the matrix. Check with RS Components before ordering to make sure you can do what you want to.

More complex display devices, very similar to the type you want are now on the market, but may not be available on a one-off basis. Try Perdix Components Ltd, Amber Controls Ltd or Epson — the last-named has recently announced a series of alphanumeric LCD displays.
P L McIlmoyle

Stringy for Nascom

I have a 32k Nascom 1 system for which I'd like reliable, fast mass storage. The review of the 'stringy floppy' in *PCW* (June 1980) stated that this was available for a number of bus systems in addition to the TRS-80 compatible version advertised in this country. How could one of these be interfaced to a Nascom?
M Gibb, Glasgow

The Exatron 'Stringy Floppy' is certainly available from the USA in versions suitable for a number of buses, notably the S100, the S50 bus and for the TRS-80. The problem with interfacing it to other computers is that, just like a floppy disk system, it needs a disk controller, implemented in hardware, to interface from the computer's control and data buses to the write head on the recorder. This controller has to code and format data, as well as directly controlling the drive(s).

In the case of the S100 and S50 buses, Exatron is providing the hardware to interface the controller to the bus control and data lines. In the case of the TRS-80, the situation is more complex.

To interface the Nascom to the Stringy Floppy you need either a special controller designed for the Nasbus, or else a Nasbus to S100 or S50 adaptor. With the number of Nascom extension modules currently on offer, I am surprised that I have not yet been able to track down such an adaptor.

So, for the moment, I can only suggest that, for 'fast, reliable mass storage for your Nascom, you consider one of the floppy disk systems on offer. They cost a lot more than a Stringy Floppy, but you should be able to get going sooner!
P L McIlmoyle

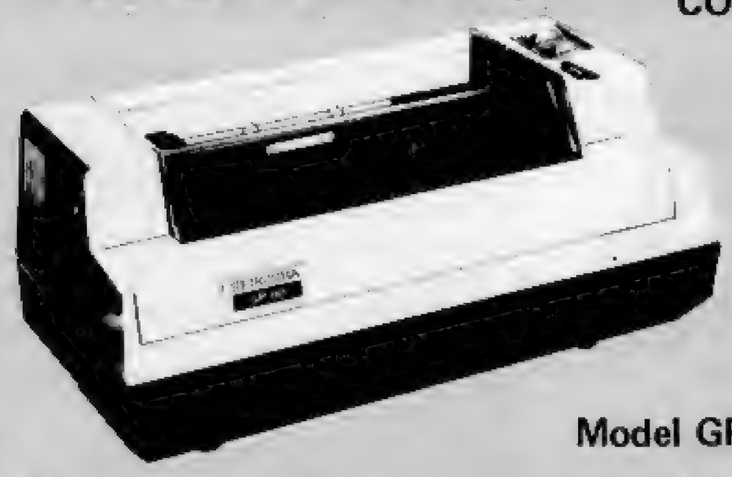
Printers and multi-users

I have in mind an application which requires a multi-user system as the volume of work grows. I also require a printer capable of printing normal characters at variable line spacing and pitch. Is there a printer available which can, under software control, jump from normal output of, say, eight char/in and eight lines/in to other densities? Which micros could it be interfaced with?
Name and address supplied

There are several such printers available but two worth looking at are the larger Anadex and the Qume Sprint 5; their prices are £950 and £1800 respectively. The Qume is a daisywheel capable of superb quality print and *all* of the functions you request. It is rather slow, at 50-60 char/in, whereas the Anadex is capable of working bi-directionally at 150 char/in. Each of these printers will interface with virtually any machine so there is no problem there.

As far as multi-user systems are concerned, I would need to know far more in order to ascertain a suitable one for you. But *PCW* has just started a series on multi-user systems, so you should be able to glean some helpful hints from that.
SW

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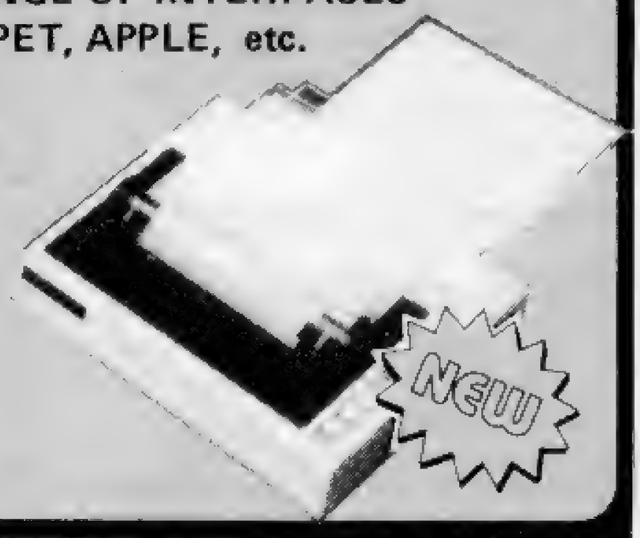
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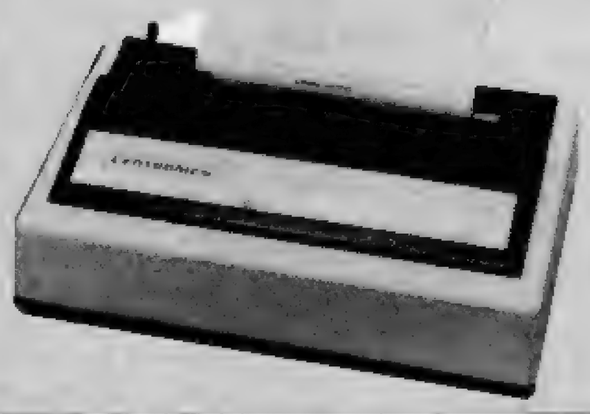


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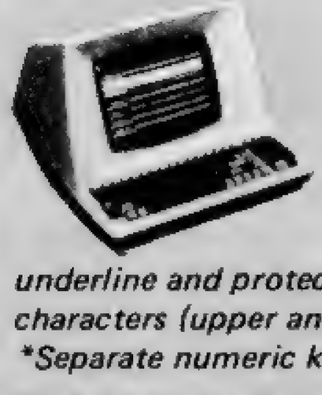


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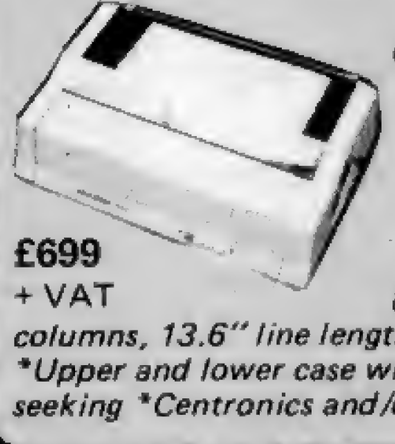
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BOOKFARE



Malcolm Peltu reviews several books which cover the social and political implications of micro technology.

Dialectic Siliconism

Technology is not neutral. It exists in a social, political, economic and industrial environment which shapes the direction in which technological power is channelled. Computing and microelectronics have been offsprings of the Western capitalist world. Micros, in particular, flourished in the climate of entrepreneurial growth which was a feature of American society in the 1960s and early Seventies.

The environment in which this technology has expanded has been primarily directed towards increasing profits — profits of the manufacturers and suppliers of systems and productivity and profits of organisations using them. Valuable social gains, such as personal computing, education, health and other services have come more as a by-product than a central thrust.

Is such a pattern of development inevitable? Does the failure of communist countries to come anywhere near Western technology in this field prove that information technology is, by its very nature, a discovery and tool of the capitalist? Does the 'neutral' technologist and scientist have a responsibility for the way innovations are developed and used? Can capitalism cope with the employment consequences of micro-inspired automation — and can communist countries cope without the aid to industrial productivity brought by the micro?

Communist playwright Bertolt Brecht had no doubt about the duties of the individual scientists and technologist. In a new special report, the UK Conference of Socialist Economists (CSE) has no doubt that microelectronics is a capitalist technology which is being ruthlessly used to oppress workers and break the power of unions. And a book on the Soviet use of computers leaves little doubt that the ideological attitude of a government can inhibit the development of an important technology.

The introduction of a dead Communist playwright into a review of books about computing may seem strange. But Brecht's *Life of Galileo*, which was revived last year at the National Theatre in London, is a magnificent and balanced analysis of the very modern contradictions of scientific and technological research — the optimistic desire to pursue knowledge for its own sake opposed to the ever-lurking possibility that the end result may be socially divisive or physically disastrous.

When I saw *Galileo*, I was in the middle of reading *Microelectronics — Capitalist Technology And The Working Class* by the CSE Microelectronics Group, and *Computers and Economic Planning: the Soviet Experience* by Martin Cave. In my perception these three works became interwoven, with *Galileo* standing above the other two like a mocking Colossus.

Brecht shows how the Church in the 17th Century forced Galileo to recant his theories about the nature of the solar system (Earth going round Sun, not vice versa) because it went against current theological doctrine. Even more importantly, Galileo threatened the authority of the Church because he had popularised his scientific beliefs, leading to unrest among those who had previously been cowed by the Church's apparent omniscience.

After recanting, Galileo was placed under house arrest but still managed to complete the *Discorsi*, which became the foundation of much of modern physics, and which he had smuggled out of Florence. But, in the play, he tells a former pupil that perhaps it would have been better if he had stood firm and not recanted, even if it had meant that he could not have written the *Discorsi:*

'Had I stood firm the scientists could have developed something like the doctors' Hippocratic oath, a vow to use their knowledge exclusively for mankind's benefit. As things are, the best that can be hoped for is a race of inventive dwarfs who can be hired for any purpose,' he says, adding later, 'I handed my knowledge to those in power for them to use, fail to use, misuse — whatever best suited their objectives. I betrayed my profession. A man who does what I did cannot be tolerated in the ranks of science.'

Brecht strengthened Galileo's attack on the supposed primacy of the notion of 'pure' research for research's sake after the first atomic bomb was dropped on Hiroshima. In a draft foreword to *Life of Galileo*, Brecht commented: 'The formula $E=mc^2$ is conceived of as eternal, not tied to anything. Hence other people can do the tying: suddenly the city of Hiroshima became very short-lived. The scientists are claiming the *irresponsibility of machines*' (my italics).

As the social consequence of microelectronics and computing begin to unfold, Brecht's message is as relevant today as it was in the 17th Century. Technology may be neutral in an abstract world; in the real world it is used primarily to benefit those who have most power and could be used negatively against those who have too little or no power at all.

The ringing irony of *Life of Galileo*, however, is that today's equivalent of the 17th Century Church's insistence on belief in those scientific theories which support the status quo is found at its worst in many countries governed by communist parties which claim to have scientific rationality as a major tenet of their belief — communist parties which Brecht himself supported. Martin Cave, in his book on Soviet computing, quotes a classic instance of dogma given higher priority than truth. In the early 1950s cybernetics was denounced in the Soviet Union as being a 'tool of the reactionary bourgeoisie and inimical to Marxism.'

This attitude was later altered and Cave says that is was even argued that the earlier denunciations of the science had unwittingly accepted a false view deliberately propagated by reactionary interests to conceal the true potential of cybernetics from Soviet scientists.

The approach of dogma first and the facts second unfortunately creeps into the CSE analysis of microelectronics. Their theoretical stance is clear: capitalists are primarily concerned with making profits; micros help to cut labour costs and therefore increase profits, so they are used by capitalists to destroy jobs and break the power of unions. 'During depressions, capitalists are impelled to search for new forms of technology that can be used to restructure the economy. Above all, they have to be able to overcome their dependence on those sectors of the working class who have used their position in the economy to build sufficient strength to act as a bottleneck.'

This theory is a serious proposition and has evidence to support it. The main reason for introducing computing and micros is frequently 'to increase productivity' and 'to make more cost-effective use of resources.' In other words, to use fewer people to make more profits, more goods, more services. Some managers *do* regard new technology as an opportunity to break the power of unions. I have frequently heard managers say (usually under the breath) that not only are micros cheap and efficient but 'they don't join unions and don't go on strike.' In many activities, computing and microelectronics are leading to deskilling of certain jobs as well as the eradication of others.

I was therefore looking forward to the CSE book to provide a new angle on the microelectronics saga; a critique on the existing environment; and an analysis of radical alternatives to the existing direction of technology. Unfortunately, it did none of these.

Firstly, there are too many places where the facts are shaped to fit the theory. Although it provides a reasonable summary of the employment impact of microelectronics in many activities, this adds very little to the many previous similar works on this topic. In common with other publications on this subject, its emphasis on microelectronics, rather than viewing information technology as a coherent entity, limits its field of vision. But perhaps my most serious disappointment was its conservatism (albeit left-wing conservatism). It seems to encourage negative resistance by workers but provides little vision of a positive alternative.

The CSE team does not seem to have heard of personal computing and has failed to even touch on the potential democratising affect of personal computing by taking computing power out of the exclusive control of big organisations. It does not look into the potential community benefits of computerised information services.

There is also no attempt to provide any kind of critique of the way computing has developed in non-capitalist countries and how it would be possible to build a society that balanced the community and social needs, with industrial and business aims and the push of technological change.

For a truly radical and alternative view of the positive application of technology, a better view is offered by the collective who publish *Undercurrents*, the 'magazine of radical alternatives and community technology.' This has the freewheeling style of the magazines like *Oz* and *International Times* in the Sixties. The use of computing for community rather than com-



mercial objectives is frequently analysed. Issue number 42 last year, for example, was devoted mainly to a blueprint for 'Protopia' in which 'convivial computing' played a major role. The magazine is well worth reading, at least occasionally, as it does provide a genuinely 'radical' approach to the application of technology.

The CSE group, however, seems to view microelectronics purely within the context of capitalist/worker struggle. In the industrial examples which they quote, such as in the automation of process control and manufacturing industries, there are genuine conflicts of this ilk. But the CSE determination to make its political point irrespective of the facts is illustrated at its worst in the chapter on software.

At first, I was impressed to see the prominence given to software. This is frequently underplayed in books about the social and employment consequences of microelectronics. It is also clear, from the references to operating systems, teleprocessing monitors and software engineering, that the group understood the nature and scope of software. (The general technical level is reasonably good when it is left free from political distortions.) Yet it has chosen to portray software developments, such as the move to high level languages, as examples of management attempts to achieve a 'sustained initiative over labour'.

It correctly describes the evolution of the software process, through machine-coded programming in the early days to high level languages in the Sixties and towards more systematic software engineering methods for designing, building and testing software packages. But it does not explain the technical logic behind this evolution and the vital necessity to have structured methods of software engineering in order to create complex software products that will be reliable and easily maintained. Instead it interprets the movement as being initiated as a means of managers mounting 'an initiative against the labour force to capture control over the production process and push down the average wage of software workers.' It criticises program management techniques designed to eliminate errors through better and more open monitoring of program development as being motivated by a desire to 'drag the labour process of software production out into the open, out of the minds and closed relations of one programmer to another.'

This it does not regard as a good thing, as an inevitable process if complex software systems are to be designed more efficiently and reliably. It regards it as a sinister attack by management on software workers, as a struggle, a battle, a fight between management and workers.

It opposes attempts to make software production a more open, well-monitored process, on the grounds that if the programmers are faced with the public availability of performance statistics on his or her programming ability, 'The programmer will then be at a disadvantage in project and careers reviews with management. The programmer can no longer appeal to a greater technical knowledge of software because the management will have documented proof of his or her errors of carelessness. *Once again a product of labour will be used to confront labour as management tries to gain mastery of the production process*' (my emphasis).

This passage highlights the central failure of their book. Blinded and blinkered by predetermined dogma and jargon, the group ends up taking up ridiculous, negative positions on issues where it could indeed make valid socialist criticisms.

Is the group really suggesting that sloppy, self-indulgent, undisciplined programmers are to be glorious Heroes of the Revolution? Why, when it accurately points out that software engineering techniques are so primitive that developing complex software is 'like having to make a saw every time you wanted to cut a piece of wood,' does it seem to oppose methods for improving software engineering? Does it regard engineering techniques that ensure bridges do not fall down are a blow against the extra work that would be obtained rebuilding bridges or as a major benefit to the users of bridges, just as it seems to perceive good software engineering techniques as being motivated more by antagonism to programmers than a desire to produce better software for users?

In its enthusiasm to turn everything into a binary good/evil, worker/manager context, it fails to make the solid case that it could about the deskilling and alienating process that professional programming could become in a structured programming environment, which has been created by a natural technological evolution. It should be discussing how programmer motivation and job satisfaction can be maintained in more disciplined software development — but that, of course, would be regarded as typical of social democrat 'tinkering' with the system to maintain the status quo.

The section on software also displays ignorance — or deliberate suppression — of the growth of personal computing, which demonstrates how technology can lead to the potential for greater democratisation and less control by the existing power manipulators.

Without the development of high level languages, which the CSE group regards as a pro-capitalist development, there would have been no Basic and no personal computing movement. (High level languages were, of course, an inevitable, commonsense development.) Personal computing has taken computing power out of the exclusive hands of the powerful corporations and large public organisations and put it in the hands of ordinary people. While the CSE group directs its spleen at what it claims is the unwelcome but successful attempts of managers to turn software into the 'private property of the corporation' rather than the 'private property' of the professional programmers, a revolution has been happening under its noses. For the first time, there is genuinely private, personal software. Software developed for big machines and large organisations have never legitimately been the property of the individual programmer.

With a personal computer, you can now really do your own programming thing. Personal computing opens up opportunities for community information networks and community computing services; it offers individuals and organisations the power to challenge the computer models used by governments and companies to justify their decisions. None of the potentially-liberating applications of computing are even touched upon in the CSE book.

It also fails to attack systems like Prestel which are being directed towards large-scale information providers and business applications, rather than at being the basis of community networks. In fact, telecommunications is barely mentioned as such.

The CSE group also fails to tackle the question of whether the desire for improved productivity and the elimination of dull or dangerous work should be a valid aim in a 'socialist' or 'communist' society. For if it is, then it becomes a duty on all those who oppose the existing political system to show how the technology should be welcomed, in conjunction with associated social and economic changes (which is the attitude of the TUC and virtually every British trade union).

Communist countries seem to have no doubt that their backwardness in computing and microelectronics is a disadvantage. If, as the CSE claims, microelectronics is intrinsically a capitalist technology, why are non-capitalist countries so keen to get their hands on it? And what is at fault in communist systems which has prevented research into such a vital modern technology, while allowing the Soviet Union to make great strides in the space race (itself a major stimulus to US microelectronic developments)?

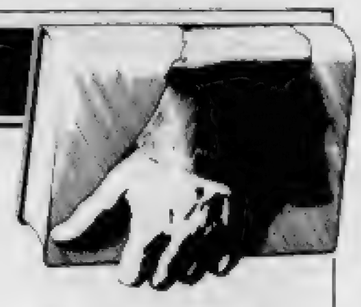
Martin Cave's book on the Soviet experience of using computers does not tackle broad questions like this. It is a description of the management and administrative uses of computing in the Soviet Union. Cave describes in great detail the programme which started in 1963 and began to peter out in the mid-Seventies which was aimed at improving the work 'on introducing computer technology and automated management systems in the economy.'

As is the Soviet way of doing things, this involved a grandiose central plan, run by a profusion of bureaucratic organisations. Cave concludes that 'one of the most conspicuous features of the whole history of the project has been the failure to meet deadlines.' In this and many other aspects -- software problems, inadequate management understanding, poor communication between computer experts and managers, shortages of skilled staff, etc — there is a close correlation between experience in the Soviet Union and in the West.

The main difference is that in the Soviet Union, the national programme was the only real forum for computing development, as opposed to the diversity of experience in the West. The Soviet approach proved to be too cumbersome to keep pace with a rapidly-developing technology and failed to generate its own new technology and respond to the applications potential of the new technology.

This experience also proves the point thrust forcefully by the CSE group — that technology is not neutral. Computing in the Soviet Union is seen as a means of bolstering and extending the existing power structure. In the mid-1960s, the Soviet regime embarked upon experimenting with decentralisation of management. The inefficiencies of total centralisation had become obvious and the computerisation programme was perceived as a means of allowing some decentralisation while still keeping close central control over

BOOKFARE



activities.

Prime Minister Alexei Kosygin commented in 1971 that 'thanks to the advantages of the socialist economic system, which makes it possible to manage economic and social processes at the level of the country as a whole, the broad application of computer technology will help us to give our plans a stronger foundation and to make the optimal decision on them.' But Cave comments, 'This promise has not been realised. The opportunity to establish an automated planning and management system on a uniform basis throughout the entire economy has not yet been taken up.'

This failure by the central government computing system — being the only one of any substance — has led to the Soviet Union remaining an underdeveloped computing country.

Cave illustrates that the role of computing in the Soviet economy was just one facet of the political process — a process in which bureaucratic socialist centrism (to coin a phrase) was finding increasing difficulty in managing the economy and maintaining control of power.

The Soviet leadership wants to maintain its status quo while attempting experimental management forms that give more autonomy to local enterprises. As Cave says 'from the standpoint of the political leadership, the new system has the merit of retaining intact many of the valued elements of centralisation in the traditional Soviet planning and management system. Indeed, to the extent that computers permit the retention of these elements, they can be seen as a conservative influence in Soviet economic management.'

Twixt the 'devil' of capitalism and the deep red sea of communist authoritarianism, where does the scientist/technologist and the ordinary person stand? How should the millions of British unemployed and the fighting Polish trade unionists view new technology when it seems to be boosting authority rather than loosening the grip of the powerful?

I believe that microelectronics has greatly boosted the democratising *potential* of the technology and I would like to see a better analysis of radical alternative uses of technology, than that of CSE. But it is Brecht in *Life of Galileo* who summarises what seems to be the unfortunate reality.

Galileo says to a young disciple: 'Can we deny ourselves to the crowd and still remain scientists? The movements of the heavenly bodies have become more comprehensible but the people are as far as ever from calculating the motives of their rulers. The battle for a measurable heaven has been won, thanks to doubt; but thanks to credulity the Roman housewife's battle for milk will be lost time and again.

'To what end are you working?' he continues. 'Presumably for the principle that science's sole aim must be to lighten the burden of human existence. If the scientists, brought to heel by self-interested rulers, limit themselves to piling up knowledge for knowledge's sake, then science will be crippled and your new machines will lead to nothing but new impositions.

'You may, in due course, discover all that there is to discover and your progress will nonetheless be nothing but a progress away from mankind. The gap between you and it may one day become so wide that your cry of triumph at some new achievement will be echoed by a universal cry of horror.'

And as you, dear reader, beaver away at your Basic program or new accounting system, these words are worth recalling. Technology may be fun and it may be profitable but is it advancing the general welfare of mankind or reinforcing existing unjust and painful ways of life?

(The words from Galileo *in this review are from a recently published translation by John Willett, which also includes notes on the play by Brecht; the latest National Theatre translation by Howard Brenton, in slightly more modern, muscular English, is available from the same publisher.)*

From macro to micro

Most discussions about the employment impact of micros have been macro. They have discussed the macro-economics of national and international trends which are not of great benefit when trying to plan the real needs of a particular local area.

Tameside Metropolitan Borough Council in the North West is therefore to be congratulated on initiating a study in October 1978 to examine the impact of microelectronics technologies on Tameside industries in the next decade. The results of the study have now been published as a book, *The Effects of Microelectronics Technology on Employment Prospects.*

Although — or perhaps because — it is concerned with local effects, this report provides a much better insight into the real employment implications of micros than the more global studies. It also shows the difficulty of predicting unemployment effects of a specific technology at a time when the overall economic climate is so poor.

For example, ICL manufacturing plants around Manchester fall under the Tameside area. The study team had estimated that the total amount of micro-inspired unemployment in the electrical and instrument engineering industry in Tameside (including ICL) would be about 260 jobs. Yet after the study was completed, one of the ICL factories was closed down, leading to a total of 800 staff being made redundant.

The approach of the report is to analyse, industry by industry, the likely impact of microelectronics directly on employment and also to estimate other indirect changes which may result as new technology generates changes in the nature and structure of industries throughout the world, including the way competitive effectiveness is gained or lost.

In a time of general economic growth, the overall conclusions would not be too depressing. The study team estimates that, in the 1980s, less than three percent of jobs in the area will be directly lost because of microelectronics, although they think that up to ten per cent could go if there are extensive 'structural displacements' in industries as a result of technology.

This, however, has already been shown to be an underestimate by the way interest rates, exchange rates, cuts in public expenditure and the other shadows of recession have already increased unemployment through closures of factories like ICL's plant in the Tameside area.

In particular, their estimate of redundancies in public administration seem to be over-optimistic in the light of current developments.

The authors of the study admit: 'It is difficult to predict employment changes in the public sector. Local government and the health services are large employers in Tameside. Major cuts in their expenditure because of national government policy might necessitate the introduction of labour-saving technologies in, say, the office-work side of their activities.' It is clear that the intention of the Thatcher government is to cut public expenditure and, almost inevitably, employment levels in the public sector.

Despite these misgivings about the accuracy of the predictions, this study is well worth reading by anyone interested in the impact of micros on employment. It illustrates the importance of examining particular areas and industries in detail before jumping to any conclusion.

Indirectly — and in terms of employment levels at least — the study also makes a more trenchant political case against current government policies than the CSE book reviewed above. It shows that the potential seriousness of the position is so great that it cannot be left to free enterprise to sort out both the macro and micro employment difficulties. Some public intervention to encourage new industries, to provide adequate education and training and to alleviate the human suffering of unemployment are vital.

It also dispels the complacency generated by those optimists who argue that as many new jobs will be created by technology as those destroyed. This view is a smoke screen which covers the real suffering that even limited and localised unemployment can bring.

The authors of the Tameside report comment: 'If the complete microelectronics revolution should lead only to the closing of ten factories in the whole world and all those ten happened to be in Tameside then, even though globally the employment impact of microelectronics would be tiny, it would be little short of catastrophic for Tameside.'

The following were included in this month's Bookfare:

Microelectronics — Capitalist Technology and the Working Class by the CSE Microelectronics Group (Ultra Violet Enterprises, 25 Horsell Road, London N5, £2.95 paperback, £8.00 hardback)

Life of Galileo by Bertolt Brecht translated by John Willett (Eyre Methuen, £2.50)

Computers and Economic Planning: the Soviet Experience by Martin Cave (Cambridge University Press, £11.50)

Undercurrents magazine (published every two months from 27 Clerkenwell Close, London EC1R 0AT and available at some bookshops.)

The Effects of Microelectronics Technologies on Employment Prospects — A Case Study of Tameside by Kenneth Green, Rod Coombs and Keith Holroyd (Gower Press, £12.50)

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PUNTER'S PET

Beat the bookie at his own game using this PET system devised by Alan Green



Have you noticed every bookmaker you see wears a good suit and drives the latest limousine; at least it seems like that, doesn't it? Well, I can't guarantee the car and the suit but I can introduce you to the world of the bookie, show you why he makes money and why the punter loses and give you the chance to become the exclusive bookie on the PET racecourse.

Why the bookie wins

Imagine a horse race of five horses, all of which have an equal chance of winning. This means that each horse has one chance in five of victory or four chances of not winning. Hence there are four chances against the one of winning, or in the jargon of the bookie, it has odds of four to one against. If one horse was thought to have more chance of winning than the others then its odds would be less, say three to one or five to four (1¼ to one). A horse of lesser chance would have longer odds of perhaps eight to one or greater.

Returning to our original race of equally matched horses, each one is rated as having a 0.2 probability of winning and, if we add up the probabilities, they total 1.0, which is the probability of a certainty — namely one of them winning. On the assumption that the punters know no more than the bookies, it is reasonable to expect bets to be laid fairly equally on all five horses. If we assume that a total of £100 is bet, then that would be £20 on each horse. Whichever horse wins, the bookie will pay odds of four to one; he will pay out £80 plus the £20 stake returned — total £100. This means that £100 has been bet and £100 has been won and the bookie has made nothing. Bookies aren't like that: they want to make money. The way they achieve this is as follows:

If a horse has true odds of four to one, the bookie will quote something less, say three to one. This means that, where the true probability of winning is 0.2, the bookie tells you it is 0.25. Doing this to all the horses in the race means two things:

1. The sum of the probabilities is greater than 1.0 (1.25 in our example);
2. The bookie will pay out less than he takes in stakes (in our example he takes £100 but only pays out £80).

This is obviously highly satisfactory for the bookmaker and, consequently, he will always make sure that the probabilities associated with his quoted odds always add to more than 1.00. This is known as 'over-rounding' the book. If the book was under-rounded, the bookie would lose money on the race. They don't do it!

To calculate the bookies' expected percentage on any race you must do the following:

1. Convert the odds to probabilities — see Table 2;
2. Total the probabilities;
3. Calculate:

$$\% \text{ Take} = \frac{P - 1}{P} \times 100$$

where P = the sum of probabilities.

The amount that the bookmaker can take varies in relation to the size of the race but 20 to 30 percent is reasonably typical; on very large races it can be much more.

In practice the bookie sets initial odds and, as bets are placed, he changes the odds to reflect the way the money is being laid. Horses attracting money have their odds shortened (ie odds reduced but probability increased), while the less-favoured horses have their odds lengthened. Ultimately the odds reflect the opinions of the punters, not the form of the horses. To further prevent losses, on small races no place bets are allowed and on other races the amounts paid for place bets vary in relation to the number of runners.

The program

The program listed is not a game in the normal sense, although a number of people are invited to 'play' with you. The program enables you to run a complete race meeting acting as race organisers, bookmaker and information service. If you could encourage your friends to play real bets with real money, you would actually make a profit. Perhaps the friendliest thing to do would be to play with raffle tickets and monopoly money. The program follows a number of phases and each one is dealt with in detail below.

Racing options

This initial part of the program allows for the input of race details either from the keyboard or from the tape file. Any

Horse	Total Bets Placed
My Fair Lady	£60
Casanova	£80
Lucky Jim	£40
Pengler	£20
Blue Rum	£ 0
	£200

Proportion of horses with bets on them = 0.8

∴ Probability to be shared by horses carrying money is 0.9 + (0.8 x 0.1) = 0.98

Probability on unfancied horse = $\frac{0.10}{5}$ = 0.02

Total probability = 1.0

	Basic Proby	Modified Proby (x 1.4)	Nearest Odds
My Fair Lady	60/200 x .98 = 0.294	0.4116	11 — 8
Casanova	80/200 x .98 = 0.392	0.5488	5 — 6
Lucky Jim	40/200 x .98 = 0.196	0.2744	5 — 2
Pengler	20/200 x .98 = 0.098	0.1372	6 — 1
Blue Rum	= 0.020	0.0280	33 — 1
	1.000	1.400	

∴ Bookmakers % = $\frac{0.4}{1.4}$ x 100 = 28.6%

The basic probabilities are used in the program to generate proportionate random numbers to determine horse placings. The modified probabilities are used for all calculations involving bets laid and payouts made.

Table 1 Example of odds calculation.

race entered through the keyboard can be saved on tape. In this way complete race meetings can be copied in from the morning papers.

The only constraints are:

i. Number of horses must be between three and 12, and

ii. race cannot exceed 12 furlongs.

If a reminder is needed on the settings of odds, the information is available.

Each horse's name (12 letters max.) is entered, together with its starting price. When all horses have been entered, the 'roundness' of the complete set of odds is checked and, if it is not to your (the bookie's) advantage, alterations are prompted. The race will only be accepted when the book is overround.

Pre-race activities

When the race is accepted, a list of runners and odds is displayed, together with details of total cash staked on each horse. With this display, only three instructions are accepted: B, O or R. B indicates the laying of a bet; O allows the revision of odds, and R starts the running of the race. Up to 50 bets can be laid either as win only or each-way bets. The only exception to this is that in fields of fewer than six horses, it is not possible to lay each way bets — this is standard bookmaking practice. All bets are made in whole units to make display easier. The displayed odds are not changed unless deliberately requested.

Calculating the odds

As the odds are intended to reflect both the horses' chances of winning and what the punters think the chances are, the following calculation is made (lines 4000 — 4200):

i. The proportion of horses with bets on them is calculated: (BR/N);

ii. 90% + ((BR/N) x 10%) of the chances of winning are allocated to all horses carrying money;

iii. 10%/N is allocated to horses not carrying money. This, in effect, means that horses which are seen as rank outsiders do actually have a small chance of winning;

iv. The winning chances (probabilities) are divided among the money-bearing horses in proportion to money they are carrying;

v. The probabilities are increased by a factor of 1.40 in line 4025 to give the bookie his margin — this can be modified to suit;

vi. A matching search in arrays AA, BB and PR then give the odds to match the probability.

Sample calculations are shown in Table 1.

The race

The race is run over the designated distance with reports of the leading three horses at every furlong. The horses are selected at random but with a probability reflecting their odds. This is achieved by forming a cumulative probability list,

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PROBABILITY WHEN ODDS AGAINST	ODDS	PROBABILITY WHEN ODDS ON
.500	EVENS	.500
.488	21 — 20	.512
.476	11 — 10	.524
.455	6 — 5	.545
.444	5 — 4	.556
.421	11 — 8	.579
.400	6 — 4	.600
.381	13 — 8	.619
.364	7 — 4	.636
.348	15 — 8	.652
.333	2 — 1	.667
.320	85 — 40	.680
.308	9 — 4	.692
.296	95 — 40	.704
.286	5 — 2	.714
.267	11 — 4	.733
.250	3 — 1	.750
.231	100 — 30	.769
.222	7 — 2	.778
.200	4 — 1	.800
.182	9 — 2	.818
.167	5 — 1	.833
.154	11 — 2	.846
.143	6 — 1	.857
.133	13 — 2	.867
.125	7 — 1	.875
.118	15 — 2	.882
.111	8 — 1	.889
.105	17 — 2	.895
.100	9 — 1	.900
.095	19 — 2	.905
.091	10 — 1	.909
.083	11 — 1	.917
.083	100 — 9	.917
.077	12 — 1	.923
.074	100 — 8	.926
.071	13 — 1	.929
.067	14 — 1	.933
.065	100 — 7	.935
.063	15 — 1	.937
.059	16 — 1	.941
.057	100 — 6	.943
.053	18 — 1	.947
.048	20 — 1	.952
.043	22 — 1	.957
.038	25 — 1	.962
.034	28 — 1	.966
.029	33 — 1	.971
.024	40 — 1	.976
.020	50 — 1	.980
.015	66 — 1	.985
.012	80 — 1	.988
.010	100 — 1	.990
.007	150 — 1	.993
.005	200 — 1	.995
.004	250 — 1	.996
.002	500 — 1	.998

Table 2 Odds and probabilities conversion table.

Horse	Basic Prob'y.	Cumulative Prob'y.
My Fair Lady	0.294	0.294
Casanova	0.392	0.686
Lucky Jim	0.196	0.882
Pengler	0.098	0.980
Blue Rum	0.020	1.000
	1.000	
Random Number	**Horse**	**Position**
.704	Lucky Jim	1st
.186	My Fair Lady	2nd
.815	Lucky Jim — repeat	ignore
.935	Pengler	3rd

Table 3

CALCULATOR CORNER

Compiled by Dick Pountain

MORE CASIO QUIRKS

At the end of my first article on this subject, I challenged readers to discover more about the operation of the non-numeric characters of the Casio 502 display. This challenge has been most convincingly answered by a Norwegian reader, Jonny Østensen of Oslo, to whom most of the following new revelations are due.

Many of you will have already guessed that these non-numeric characters are in some way connected with the hexadecimal notation used internally by the calculator. It would be expected that they would correspond to the hexadecimal digits 10 to 15 and that there would be six of them. A cursory count-up only reveals four: P, E, C and ^{0}, but pause for reflection allows us to include the '—' (RUN) symbol. The sixth character is in fact a blank space, 'blank'.

Mr Østensen has discovered the following routine for isolating and individually displaying these symbols:
23 Min1 AC Inv Ind MRI Eng Inv Ind MRI =
The display now contains '—' and looks for all the world as if a program is running. This symbol represents hex 14, as will be seen if you add 0 to it: '—' + 0 = 14. The other five symbols may be produced by computation from this first one. As you produce each one, store it in the memory corresponding to its hex value, so: '—' Min 14 (.4).

13 — MR 14 = Min 15 produces the 'blank' (hex 15) and only a decimal point is left in the display. If you don't believe a 'blank' is really there, press +/—.

11 — MR 14 = gives E, which, since it is an error message, blocks the display register so that no further input is allowed until it is cleared. To get round this, we calculate its negative form, —E, which has no such effect, so: MR14 — 11 = Min 13.

C is treated in the same way, as it's also an error message; MR14 — 10 = Min 12 gives —C in M12.

Hex 11 is P but must be calculated as 10—MR15 = Min 11, since 9—MR14= gives —5 as its answer.

Hex 10 is the ^{0} symbol but it cannot be calculated in the same way. Mr Østensen deserves a Nobel prize for uncovering this obscure route:
23 Min 1 AC 777 EXP 20 +/— ÷ Inv Ind MRI = Min 10.

You now have all six symbols stored in registers 10 through 15 and they be be recalled at will. (E and C can be *stored* in positive form but will lock the display if recalled.)

Playing around with them results in an initial disappointment: there is no way I can find to concatenate them, either with each other or with digits from the keyboard. Moreover, most arithmetic operations cause them to 'collapse' back into decimal representation. However, certain classes of operation result in combinations of digits

Address	P	C	E	—	'blank'	1P	1C	1E	1—	1 blank'
Register	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10

Fig 1

and symbols. Try this: MR11 (12,13)++====... *ad nauseum*. Or: MR11 (12,13)++0==..., or MR11 — 10 =. Perhaps some hopeless insomniac will produce a dictionary of possible combinations!

One particular group of combinations has a special significance, which will be seen later: 1^0, 1P, 1C, 1E, 1— and 1 'blank'. This may be produced as follows:
[P] x = [1P]
[P] ++= [1C]
30— [1P] = [1 'blank']
30— [1C] = [1—]
[^{0}] + [^{0}] = [1^0]
[] signifies a displayed symbol. Store these for future researches.

Mr Østensen discovered that ^{0} and 1^0 are the indirect addresses for the F and 1F (.F) registers, which are not normally indirectly addressable. So, Inv Ind Min 0 will load the F register if ^{0} is in M0. This, combined with last month's tip on loading the F register independently from tape, suggests possible unusual applications.

I found this quite exciting and began to wonder if any other symbols had such interpretations. They have; they address the L, or stack, registers L1 to L10, which are otherwise inaccessible to the user. The map is shown in Figure 1.

Data may be stored and recalled from these registers by using the above indirect addresses: 99 Inv Ind Min3 stores 99 in L3 if M3 contains —E. Any such data is erased, however, if the calculator uses that register for a pending operation. Surprisingly, if the L registers are filled up with pending operations (ten levels of parenthesis), these contents *cannot* be recalled indirectly, a zero always being returned. Indirect M+ or M— will modify the contents, however, and alter the result when the pending operations are executed.

Unlike the HIR operations on the TI59 (often mentioned in this column), these extra ten registers represent a Pyrrhic victory, since ten registers are occupied in storing the indirect addresses!

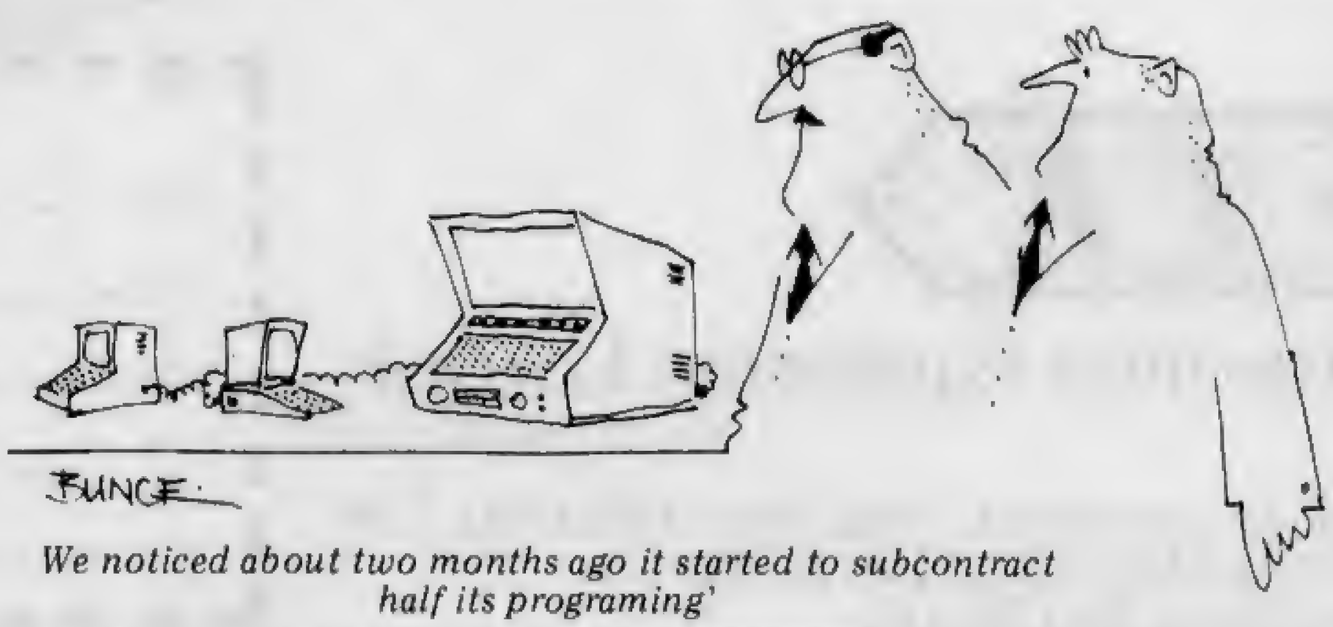
Another unusual effect, due to Mr Østensen, is that a bizarre form of indirect jump to a subroutine may be made using the symbols as addresses. If ^{0} is placed in M0, on executing Inv Ind GSB0, a search is begun at the start of program memory and control is transferred to the first step at which the digit 0 is encountered, regardless of which program register it occurs in! In a similar fashion '—' will search for digit 1, C for digit 2 and E for 3. The other symbols have no such interpretation. By this means, an extra three subroutines could be created by entering a single subroutine at three different points:
Pn. . . 1. . . 2. . . 3. . .

If you have followed the story so far, once your brain stops hurting you will probably wonder what use any of this is. I wonder, too!

One certain use is that the 'blank' symbol provides a unique way of totally clearing the display (otherwise impossible), which is nice to have. Another use is for prompting and labelling results. It could be quite convenient in, say, an electronic engineering program, to label three results with a P, C, or E. This can be done as follows:
PO Min 0 AC HLT x10+20—Inv Ind MRO =

If the 1 'blank', 1— and 1E symbols are now stored in M1, M2 and M3 then, by entering 1, 2 or 3 followed by a number, N, and EXE, the display will contain NP, NC or NE respectively; P, C and E are appended to the input N. This could be used as a subroutine to label results.

For more ambitious uses I'm going to rely on you, the reader. A small prize (a copy of *Godel, Escher, Bach*) will go to the best useful program (or subroutine) which uses any or all of these new insights. So get to it!



We noticed about two months ago it started to subcontract half its programing'

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SECRETS OF SYSTEMS ANALYSIS

PART 6: CHOOSING A PACKAGE

Lyn Antill continues her series aimed at bridging the gulf between the would-be micro user and the microcomputer specialist.

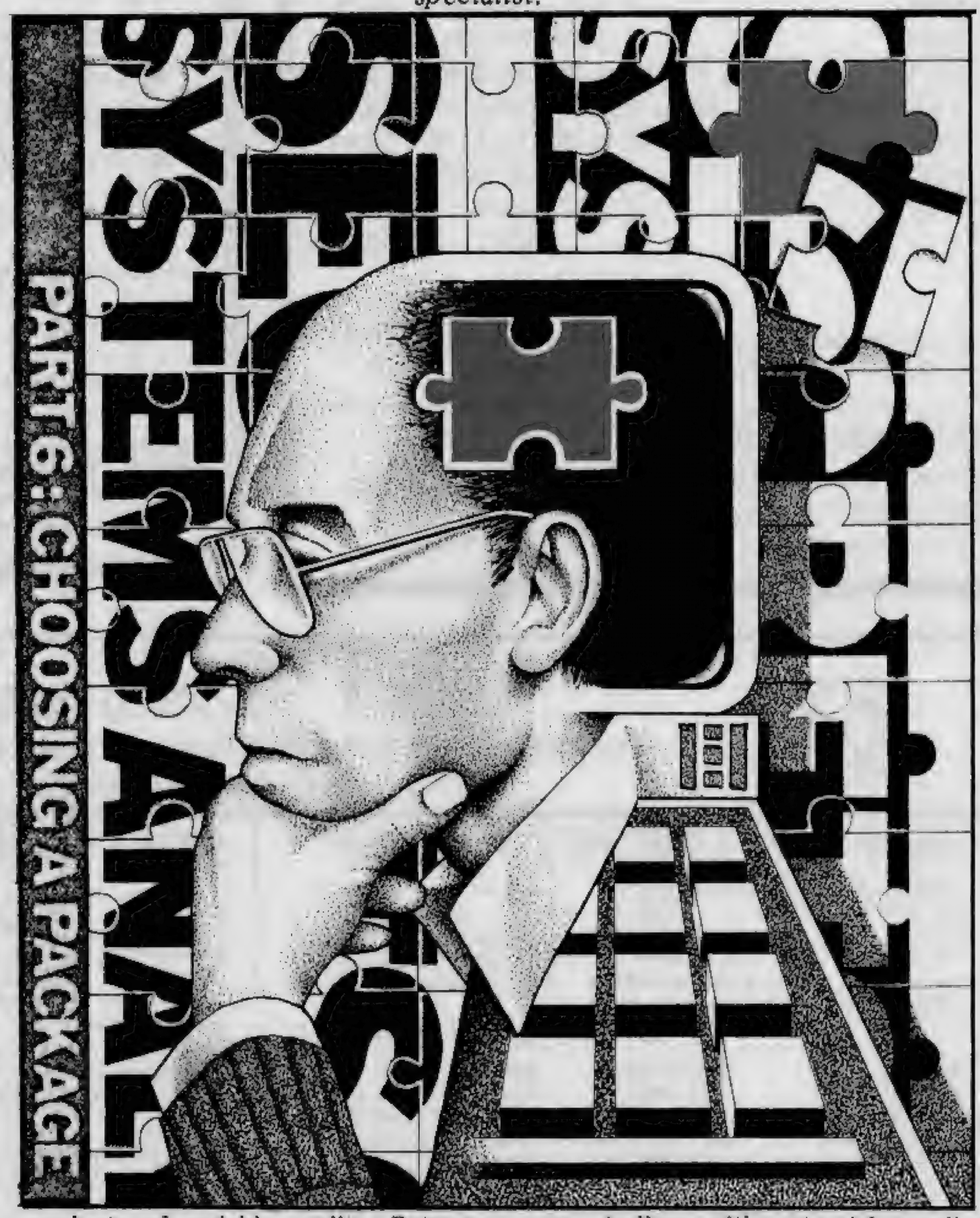


Illustration by Stuart Briers

It is difficult to believe that two years ago this article would have been about how to track down that elusive program that somebody, somewhere, had written for your machine. Nowadays, finding a package is all about sifting through the mass of what is available to find out which is the best one for you. Of course, you may still not find what you want but that is another story. Even if you decide not to buy any of the packages you see, you can still learn what you like and what you don't from them, and you will be in a better position to design a program of your own.

As I have said for the last two months, choosing a package cannot be divorced from choosing the machine to run it on. Many people buy an Apple, for example, because they want Visicalc. Others will buy Petsoft programs because they already have a PET. In these cases, half the decision has already been made and the options for the other half have been reduced accordingly.

Price range

I suppose one way of getting started on your search is to decide what end of the market you are interested in. It is convenient to divide software writers into three types. At the top end of the market are the established software houses, who are accustomed to providing mainframe software, and the manufacturers of office machinery who are now providing complete systems for office functions such as word-processing, accounting, stock-control and hotel reservations. They already have a good knowledge of their customers' requirements and they have been in business long enough to know what sort of problems lie in store for them if they provide machines or programs that do not come up to their customers' expectations!

At the bottom end of the market are the cowboys — people capable of writing Basic programs for their own purposes who think they can make themselves a good profit by selling them. You may well be lucky and find a program from such a source that serves your purposes, but you do have to make sure that it is crash-proof and that you know how to use it. There are also program-swapping arrangements among some groups, particularly in education and hobby computing.

In the middle price range, there are many software houses who write programs for micros. Some specialise in particular machines or particular programs (accounts programs, or language compilers), some are better than others and some who distribute programs bought in from different sources offer products of variable quality. Between them, they have a pretty long list of programs, covering a wide range of machines and applications.

You probably already know if you are at the top end of the market, where reliability of the system and support from the manufacturer are high on your list of necessities. If you are a home user, looking anxiously at your bank balance, then you will know that if the program isn't cheap, you'll have to do without it. But even if you are quite sure what sort of supplier you're looking for, it is still worth thinking about the other options, just so that you can put your own choices — and the prices you're being quoted — into some sort of perspective. It helps in your dealings with potential suppliers if you know what other companies are offering and what they are charging.

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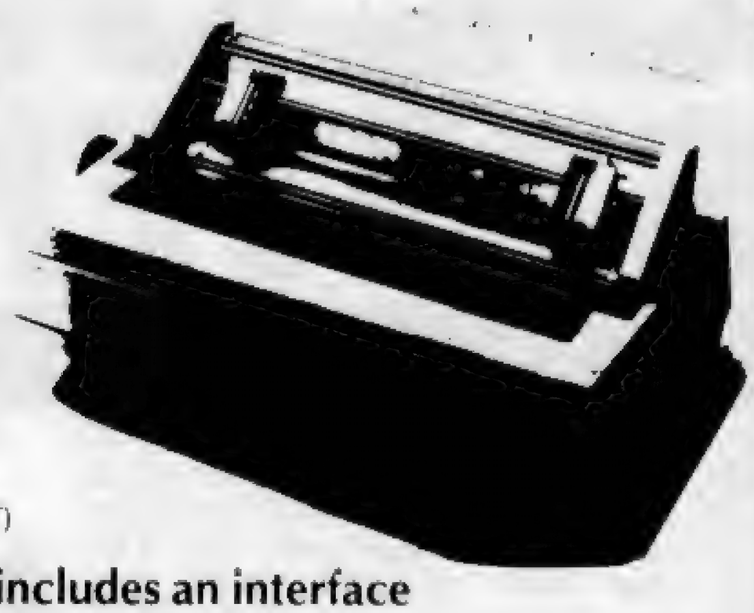
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their new systems into the current office procedures. They are concerned, not so much to create something new and exciting ('gimmicky' is how some would see it), but to use the new technology to enable managers to run their businesses more efficiently.

If you were to look at the machines they are selling and the programs they have running on them, you would probably think that you could shop around and buy something to do the same sort of job for two-thirds the price. You might also feel that your alternative system was more versatile. But the complete business system is not the rip-off that this might imply because it offers features which the ordinary package does not:

— guaranteed compatability between hardware and software (none of this business of getting the program reconfigured);
— a reputable supplier whose salesmen are used to dealing with your type of business;
— advice on security and backup procedures;
— help setting-up the system in the first place (always the most difficult job);
— compatability between your existing system and the new one (if you stick with the same supplier).

If you are not sure whether this is the right approach for you, the first question to ask yourself is whether it is actually going to be worth your while paying the extra cost in order to get this additional service (having, of course, made sure that the supplier you had in mind actually provides that service). There are two halves to this question: how much more are you paying for how much additional support; and what do you stand to lose if you don't get that support? If your business would grind to a halt if the records were not kept for a couple of days, you can't afford a system which doesn't have a water-tight service guarantee.

People are surprisingly uncritical about the book-keeping system that has grown up with the business, so that, although the first reaction is, 'of course I must have up-to-date, accurate records!' it often turns out that they have managed perfectly well for years without either. So I challenge you to look at yourself for a day or so — how often do you look at the latest figures, and how critical would it be if you only had two-day-old figures to work on, along with your memory of what had been done since? Also, how much overtime would it take to get the books back up to date after the machine had been repaired? The converse of this is: if you have been managing with old figures, would you do better if your figures were better kept?

The complete business system is often referred to as a turnkey system, ie, you turn the key and the machine jumps straight into the built-in program.

Matching a package to a machine

If you are looking just for a program, then you've got two problems. One is that it is difficult to see what you're buying — floppy disks all look very much the same. The other problem is that you have to be sure that the program you're given will actually work on your machine and this is a good place for us to start.

Certain programs are clearly designed to run on certain machines — Apple and PET programs, for example. The supplier will specify the minimum configuration needed to drive them, eg '32k SuperPET with twin 5¼in drives and a printer.' Most users are probably already aware that Apple, PET and Tandy each require their own software, at least until you have done something like put a CP/M card into the Apple. But I wonder if people know what sort of software is required for the Acorn, Atari, etc? If you're interested in buying one, you'll need to check up.

Other packages are available on a variety of machines. The great advantage of having a micro which runs the CP/M operating system is that you can run CP/M packages on it — but it is not always quite as simple as that. No machines are ever entirely standard and the programs often need to be reconfigured to take account of minor variations. Even the fact that the machine has quad density disk drives and the programs come on double density disks is enough to prevent them from being loaded directly. A programmer can usually get round some of these problems without too much difficulty, but a non-programming user could be in for a frustrating time.

The only way to make sure that the program you're looking at will work on the machine you had in mind is to get the technical specification of that machine written down and show it to one of the supplier's technical experts to see whether the program has been configured for that specification. Don't talk to the salesman (unless he's their technical expert as well) or the receptionist — they're trained to say 'yes' unless they are absolutely sure the answer's 'no'. And, anyway, they probably don't know what's likely to cause incompatibility problems between their program and your machine.

Does the program appear to do the job?

If you see a program called 'stock control', can you be sure of what it does? If *you* have goods coming in and going out you will have a very good idea of what *you* mean by 'stock control' but can you be sure that the writer of the program agrees with you? Alternatively, you may be looking for a package because your own stock is getting out of control, and you're not quite sure what to do about it. Will this program actually provide your solution? In point of fact, none of the 'stock control' systems I've yet seen on any micro lived up to that title. They were actually stock recording programs designed to provide the user with the information needed to do the controlling himself. For example, they can generate lists of items that are out of stock, or below the re-order quantity, but they don't actually create orders for the goods, or change the value of the re-order level for items whose level is, on the one hand, consistently too high, or which, on the other, are continually running.

So how do you find out what the program does? The ideal is to see it running on some real data somewhere for a real user. For popular programs this may well be possible. Often, dealers have a demonstration version of the program with some sample files built-in. These can be useful for getting an idea of what the program does. At least they can help to weed out those programs which are obviously unsuitable. There are, however, two things which are very difficult to establish with sample data: how the program behaves with large data files and how good the security and backup procedures are. For example, I was testing a package of accounting programs and I wanted to inspect the day's end procedures. It was both pleasing and frustrating to find that I couldn't do this because the first job to be done at day's end was the taking of backup copies of the data and the program wouldn't continue until I had done this. I was pleased, because it showed a high level of security had been written into the program, but it meant I had to go out and buy a spare disk before I could finish the test! Any showroom test of a demonstration program is likely to be limited by such practical problems.

Even worse is the common situation of ordering programs from a catalogue. This is very unsatisfactory but it is one of the ways in which suppliers keep down their overheads and, consequently, their prices, so it does have some value. There is nothing lost if you speak to them on the telephone, and read all their sales literature. You will probably find that they say something like 'Program with manual: £295; Manual only: £10'. If you're interested, but not convinced enough to part with £295, it might be worth buying the manual. It could prove to be a waste of money but at least then it's a waste of not very much money. If, however, you like what's described in the manual and in the supplier's small print, you can buy the program (making sure you get credit for the cost of the manual!).

Program manuals

Obviously, these are a good guide to what the program does. But it's often difficult to follow a manual when you haven't go the program to try it out on and you may wonder whether it's you or the manual that is to blame when you can't make sense of something. If you're in any doubt, it's probably the manual. Only the largest companies employ technical writers and put any real effort into creating manuals for the genuine enlightenment of lay readers; smaller companies don't have that sort of money to spend. Even bearing in mind the financial constraints, however, some manuals leave a lot to be desired. A good manual gives a good impression of the product that it describes, and vice versa. Some good programs come with sloppy, skimpy or even inaccurate manuals and some otherwise reliable companies put out the odd bit of sloppy literature written in the rush to launch a new product. But if you don't like the manual, it does make you wonder about the program.

A manual is used for three purposes:
— as a means of finding out in the first place what a program does;
— for instruction on how to set up the data and run the program;
— as a reference for looking up how to

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do the odd tricky bit.

A good — and therefore probably expensive — supplier will offer some help with the first and second of these, particularly the second. It takes quite a lot of confidence to commit your records to a computer. You may already have confidence in your ability to set up a computerised system but if you are wary, a comprehensible, comprehensive and reliable manual can be a great help — if you're the sort of person who gets on with manuals in the first place. Many people learn much better from practical demonstrations.

What matters when you are contemplating buying a package is whether you think you are going to be able to work from whatever you are being offered in the way of both practical training and manuals. If you don't think you can manage, then don't make the mistake of supposing that you can't get anything better. I've seen too many people driving themselves bananas trying to make sense of crummy manuals.

Is the program crash proof?

A few weeks ago, someone asked me during the course of a lecture, what it meant when I said a program had 'crashed'!. Well, I learnt that term in 1964 when the pattern on the oscilloscope of my valve computer froze, indicating the memory location of the instruction it couldn't operate. For the benefit of those of you who have not had the sobering experience of a program crash, or who have not recognised it as such, let me explain the term.

A program crashes in much the same way as a car — it hits something it can't get through, so that it can go neither forwards nor backwards, by cancelling an invalid entry for example. The program is stuck trying to execute an impossible instruction but without any way of recognising the impossibility and stopping itself. The program may just freeze, or the operating system might abort the program, leaving the data in an unpredictable state. Obviously, you don't want a program that is likely to crash! 'Robust' is the word used to describe a program that is reasonably crash-proof. How do you find out whether a program is robust?

Once the initial testing is over and the program seems okay, a crash is most likely to occur in those areas where it is trying to handle an inherently tricky scenario — such as running out of space for storing the data, when the operator is trying to correct a mistake, or when the operator accidentally tries to do something the program wasn't expecting.

It's difficult for a programmer to get into the mind of an operator who has no idea of how the program works; programmers often understimate the tangles that operators can get into, especially when trying to correct a mistake. It is these tricky situations which the inexperienced programmer takes least account of, not realising the extent to which the program will be abused over the course of a year's use. So, if you want to try out the quality of the program, do all the stupid things you can think of — typing punctuation marks instead of numbers, totalling out in the middle of an entry, entering an invalid transaction and then trying to cancel it. If the program seems resistant to these attempts to sabotage it, then it is probably well-written in other ways.

The sort of program crash that occurs when files are full is much more difficult to test, because it takes time and effort to enter that much data. If you are really concerned about this, then you will have to go to the effort of setting up a full-scale test but you are unlikely to be able to do this until you have bought the program — or convinced the supplier that it is worth his while putting in the extra effort to get your custom.

However hard you try, there is no program that is going to be proof against all eventualities. You need to look at the small print to see what guarantee of service you are being offered for program errors.

User friendly

The ideal to which many computer theorists are working is the machine that understands English — so that you could just give it the morning's mail to read and have a friendly chat with it to find out what was going on. Voice-activated input, optical character reading and 'natural' query languages are all realities, albeit with considerable practical limitations. But there is a great deal that even the simplest micro program can achieve in the way of user-friendliness.

In particular, there are many ways in which a program can guide you through its own operations. All of these involve more coding (and hence more programmer time then is required for the straight processing) but they are of immense value to the novice or the casual user. Even the experienced key punch operator who appears never to look at the screen, still needs to be reminded occasionally of where she's up to.

A program may be menu-driven: at each stage you are invited to chose between several available options (including the option to drop out of that section of the program altogether and enter another). If the menus are well designed and the options self-explanatory, you can quickly learn to find your way around the program. This is often preferable to working through a manual. It is necessary for this type of program to keep some control over your selection of menus — just as the program I mentioned earlier wouldn't let me select 'CLOSE THE DAY'S BUSINESS' until after I'd selected 'MAKE BACKUP COPIES'.

A program can also guide the operator by means of 'dialogue', by displaying messages, instructions, prompts. Well-designed, these can be very helpful.

The advent of the memory-mapped screen has enabled the use of 'forms mode' input. During the whole of an input run, the screen is set up with protected fields which look like the headings and boxes on the form from which the operator is working. The cursor moves from one box to the next as each item is input. This is much quicker and easier for the operator to follow than is the use of prompts. If the program detects an error in the input, a warning message is displayed and the cursor returns to the box where the error occured and stays there until an acceptable input is received. The operator is also given the chance to change the entry in any of the boxes if s/he notices a mistake. If you are going to be doing a lot of data entry, or if individual transactions are likely to be complicated, then forms mode input is a great boon.

One marvellous idea that I have heard explained by a programmer working in the field of business micros is the use of graphics for output. I have not yet seen it used, but I think it has a great future. He gave an example of a hotel reservations system where the manager wanted to know how well bookings were going. The idea was to create a bar chart where times of unusually low bookings would be immediately visible. Very often, when looking at output, one is interested in trends or approximations rather than in exact figures and a graphical output is far more meaningful than a series of numbers.

Volumes of data

One of the first things a user must do is to discover the volume of data he wants to store and the number of transactions that may go through in one day. Can the program you're looking at cope? The formulae for working out how much storage capacity you've got are always fiddly. The supplier should be able to give you a rough figure to work to. If this appears to be a bit close to the mark, then you need to look at the program in more detail. If you are in any doubt, then you must consider whether your business is likely to expand in the next year or so. If you can barely cope now, then you won't be able to if you get 50 percent extra work.

The question of the speed at which work can be processed depends partly on your expertise in using the machine. You'll speed up as you get used to it but only up to a point. If you are aware of waiting for the machine when you are trying out the program, then you will always be spending time waiting for the machine, no matter how competent you become. This may not matter — you may have had to wait a great deal longer for a manual system to do the same thing. But if you are going to be putting a lot of work through, or if you're always going to be in a hurry for the results, then you must look for something faster.

Conclusion

I haven't talked very much about the task of deciding whether the program actually does the job you want — only you can recognise that. Instead, I have concentrated on helping you to find a package that does that job well, one that you will be able to learn easily, set up accurately, use reliably. Prices for programs vary enormously. You might get a simple calculation program for £20, or spend £2000 on a group of highly reliable, well-integrated programs to do all your accounts. Shopping around for a cheaper program, or patching up a shoddy one, may well cost more than buying an expensive one.

Next month I'll be looking at what to do if you can't find the program you want and decide to have one written.

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GATEWAYS TO LOGIC

CHAPTER 7: SYSTEMS - THE BROAD VIEW

Derrick Daines pauses in his series on teaching microcomputing to others to consider systems.

We began by considering the language and practice of logic. We have looked at the connection between decimal numbers, hexadecimal and binary, and we have seen how almost any information can be coded using binary techniques, and therefore handled by the computer. Latterly we have spent some time looking at how a computer works and how this ties much of our earlier work together. At this stage, our students should therefore have a good conceptual grasp of the computer, but unless other studies of, and work with, computers have proceeded in parallel, all their knowledge will be hypothetical, divorced from the real thing. At this point in the series it might be a good idea to step back a little and take a broader view.

Many people confuse the term 'computer' with 'computer system' and, using a sort of shorthand, all of us fall into the same trap which is very confusing for students. The plain truth is that a computer by itself can only sit there doing nothing – or apparently doing nothing. In fact, as long as a computer has power applied, the clocks are belting away and the machine is constantly doing the rounds of all its input points, looking for something to do – like our play in chapter 3, with the child in the middle looking for a message to carry. By itself, though, the computer is useless. It has no ears or eyes on the outside world and, knowing nothing, can do nothing.

When we talk about a 'computer' we are really talking about a 'computer system' – it only starts to make sense when other bits and pieces are added. These are called *peripherals* which are used for communicating with the outside world or storing vast quantities of information. Typical peripherals are keyboards, disk drives, printers and TV monitors.

The system installed

It should be apparent that our definition of a computer system as a computer connected to peripherals is too narrow. We need to take into account the whole environment of the computer and especially where it impinges upon the human being.

Breaking off for a moment, we may point out that *all* computer systems eventually lead back to the human. True, we may have a system working in isolation somewhere, perhaps collecting data from a desert pipeline, but eventually that data is accessed by a human being. No matter how complicated we make the system – perhaps by having a central computer controlling dozens of others – eventually all data paths load to the human.

Now anyone who has suffered the installation of a computer at their place of work will tell you that developing a computerised system can be a most traumatic experience. Let's imagine that the owner of a garage wishes to computerise his operations. He decides to concentrate on billing because he finds great difficult in keeping track of costs and the complications of VAT, not to mention customers who pay late, by instalments or not at all. It would not serve him in the slightest to buy the best computer that he could afford, plus lots of exotic peripherals. True, he has a computer system in the narrow definition of the term, but it is no good without dependable software (programs). And he must go through a long and careful investigation – called Systems Analysis – to ensure that the computer is put to use efficiently and effectively.

Teachers are urged to seek permission from local companies to allow them to take students into their computer room. Many will allow this, but others provide a viewing gallery. At first there might not seem to be much point – the computers are immobile and cased in seemingly sterile units – but with luck and a little prompting someone in the firm might be induced to talk about the wider system and show examples of inputs and outputs. From these, the necessary organisation may be deduced.

Myths and realities

Computer systems began by being exclusively the tool of mathematicians and cipher decoders. (See, for example, *Ultra Goes to War*, Ronald Lewin, Book Club Associates, 1978.) As a consequence, the computer gained an aura all its own comprising three parts: (i) the computer was seen as being beyond the understanding of anyone with less than a Doctorate in higher mathematics; (ii) it was seen as being beyond the needs of anything less than a government agency or international company; and (iii) it was considered to be infallible. Every single one of these three parts of the computer's reputation was wholly undeserved and totally misleading.

So far in this series we have concentrated upon the first fallacy and it is to be hoped that we have given an insight into how computers work. Later, we shall devote time to a consideration of infallibility. What about need? Does our muddling garage owner really need a computer? Sooner or later, yes, he probably does.

The profession of book-keeper probably made its first appearance in ancient Sumeria and it arose out of a real need. The work-load and number of clerks rose steadily through the ages, more or less keeping in step with burgeoning populations, until the amount of data being dealt with assumed terrifying proportions. At least one SF writer postulated that man would, perforce, have to colonise the Moon and planets, simply to have somewhere to store books and files! (Simak, *Jackpot*, 1956.)

Information is truly the life-blood of the world today. For example, if a government is to make rational decisions about matters closely affecting its populace, then it needs information about that populace – and the more up-to-date the better. In the event, computing was forced upon us; a need far in excess of that of the Ancient Sumerians. In the early part of this century, for example, the US government was faced with another census before it had completed hand work on the previous one. A man called Hollerith invented a mechanical computer to do the work and founded a company to exploit the invention. Later, the company grew into what is now IBM.

As with governments, so with international companies. It is well known that General Motors of Detroit handles an annual budget far in excess of that of some countries. Could it seriously be

GATEWAYS TO LOGIC

imagined that in a competitive market they could make rational decisions without computers?

The pressures reach downward. Medium- and then smaller-sized companies realised that in order to compete and stay alive they had to make more and more efficient use of manpower, materials and capital.

If that seems a little too theoretical for you, let me recount two apparently disparate events. One day I watched on TV a program which showed the rising fortunes of a Japanese manufacturer making zip-fasteners in this country. In a few years he had taken over 60 percent of the trade due to his high level of automation. Many small British manufacturers had been forced out of business.

The following day I read in an international trade journal that British computer experts of all kinds are widely regarded as the very best in the world. Apparently there is something — we know not what — in our attitudes and mentality that makes us that way. The only problem is, there are not enough experts to go round.

Disparate, unconnected events? I think not. The one shows up the problem in stark reality. The second shows us the solution.

It might be pointed out that there is a confusion of terms here and that computers and automation, although compatible, are nevertheless separate concepts. That is to say, automated factories can be computerised, but there is no necessity that they shall be so. The producers of the TV program did not make clear whether or not the zip manufacturer had computerised, by the way. The connection between computers and automation, however, is the microprocessor, which is a computer in miniature.

Now there might not seem to be any immediate connection between (say) the ability to play a good game of Startrek and being able to design a microprocessor-controlled piece of machinery, so it may be worth spelling it out.

Because the microprocessor is a sort of computer in miniature, it has the same characteristics as a computer. That is to say, it is useless and uninteresting without peripherals. We cannot therefore train our pupils on the microprocessor directly, but may do so only when it is part of a system. As soon as we add switches or whatever to the micro, we have what is in effect a miniature computer. In fact, many thousands of home, hobby or training computer systems are in use which comprise very little else.

What you do with the system is up to you. You can use it as a word processor, play games, learn to write programs or study the workings of the microprocessor itself. No matter what you do with it, however, you are learning to live with the system. You are familiarising yourself with the broad characteristics of all such machinery. You are enriching your experience and extending your education.

The new Classics

We all want the very best education for ourselves and our children and it used to be said that the best education was a classical one — Latin and Greek — because they promoted logical thought. Not being a Classicist, I cannot judge, although I can see that this might well be so. However, one of the unspoken aims of this series is to show that the same is even more true of a computer education. Moreover, whereas a classical education is strictly limited in its practical applications, the uses of a computer-oriented education grow daily and its need, more and more urgent, both nationally and individually.

Universal education came about when it was realised that, in order to get the best out of the new machines of the first Industrial Revolution, a literate workforce was necessary. Instructions and notices had to be read, timesheets made out, and so on. At first, only a section of the workforce was encouraged to read and write, but this was later extended to everyone and nobody doubts that this was right. A modern highly industrial nation *needs* a highly literate population.

We are in a parallel situation now. We need a computer-literate population. The muddling garage owner of our example will, in all probability, go out of business — he will certainly never become rich because too much of his billing is based upon 'guesstimates'. If his bill is too high he makes a disgruntled customer; if too low, it costs him hard cash. Either way, he loses.

If, on the other hand, the owner and his workers, customers, clerical staff, suppliers and all their wives were computer-literate, the owner would push his computerisation through despite teething problems and have an efficient, profitable organisation to show for it. It should be clear that computer-literacy does *not* mean that all the people mentioned should be able to operate the computer, and still less does it mean that they should be able to program one! What it *does* mean is that their education (post-school if necessary) should take the computer into account. Ideally, they would have had hands-on experience, but at the very least they should be familiar with the terminology and basic principles, with a friendly disposition towards the machine and not hostile to it, as many are at present.

Despite the work on ciphers, another fallacy grew up that a computer system was to be mainly used for manipulating numbers. Progress over the last few years seems to have knocked that well and truly on the head, but considerable work remains to be done in order to convince everyone that the computer and its concomitant systems will invade *all* aspects of our lives, generally to our benefit. The only way to do this is to (i) show the range and speed of peripheral devices, (ii) show how they can be assembled into an almost infinite variety of systems, and (iii) attempt to extrapolate into the future.

That is the purpose of the rest of this series.

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and, finally, Larry Wood of Birmingham won the Sharp MZ-80K, more on this next month.

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GET ON THE RIGHT TRACK

Geoff Barton concludes his description of a real-time control experiment based on a model train layout.

Scheduling

The concepts of 'timesharing' or multi-tasking are well known to most computerists but the intimate details are more tricky. The method of scheduling the route tasks which run on this system is, hopefully, easier to follow than that used on larger systems since there is no need for 'pre-emptive swapping out' of tasks.

The one big assumption that is made for the system is: 'Each task will either suspend itself or complete within a finite time.' This requirement removes the need for the system to intervene and suspend a task before handing over the processor to a different one. Also, since each task executes a 'high level' instruction set there is no duplication of the large scale 'low level' routines, so enabling all the tasks to reside permanently in memory. This removes any swapping in and out of tasks onto backing store, since tasks do not require large amounts of memory space.

There are three means by which an executing task can give up the processor. When the train has reached its destination and has freed all the resources it was using, the route task has fulfilled its purpose and so is laid quietly to rest.

The other two methods only suspend the task temporarily and it will resume execution at a later time. The most common of these is when the engine pulling the train is known to be in one section and is expected to enter the next one on the route in the near future. Rather than hang around waiting for this event, the task is suspended until it occurs, thereby allowing the processor to be free for other tasks to use.

The third and final method is used when a collision is about to occur and so one of the trains is stopped to let the other get out of the way. Instead of complicating matters even more by getting the task which frees the resource required by the suspended task to restart that task, a programmable timer is used to suspend it for a period of two seconds. At the end of this delay the task is restarted and again tries to allocate the resource(s) it needs. If unsuccessful, this delay cycle is repeated until the first train has passed by and freed the necessary resource(s).

With reference to Figure 3 we will now discuss the program flow through the processor when it executes two route tasks concurrently. These routes have both been automatically generated by the system software. The operator has twice used the 'R' command and needed only to enter the start and destination section numbers for the routes to be calculated. The two routes to be discussed are from section 04 to section 27 and from section 25 to section 00 (see Figure 2 last month). Please note that Figure 3 does not have a consistent time scale.

The processor spends most of its elapsed time in a 'wait for interrupt' state. This is to speed up the handling of interrupts which synchronise all of the events in the system. There are 16 different interrupt sources possible to the processor. The Console Command Processor (CCP) section of the program checks after each interrupt has occurred whether a character has been typed on the console. If the operator has typed the letter 'E' then the code which begins execution of a route task is run. The only parameter this command requires is the route number of the task to execute.

Since we know that within a finite length of time the task which is about to begin execution will be suspended, we place onto the system stack the necessary arguments to cause the processor to resume execution of the CCP code. We then allow the task to 'run' its t-code program which allocates resources and controls the layout, so that the train begins moving to its destination. Eventually, the task will be unable to do any further processing until the train has entered the next section in its route — let us say this is section 26. The time at which this will occur depends on so many parameters, (length of section, speed of train, weight of coaches, type of engine, etc) that it is incalculable. It is therefore not possible to predict the event so the task is suspended until the train enters the new section and generates an interrupt to the processor. The task uses the 'reqint' subroutine to place a request for its resumption when this event occurs and is then suspended. Since it calls this routine by a 'jsr' instruction, the return address is saved on the stack. The 'reqint' routine removes this from the stack and saves it, together with the route number as a 3-byte entry in the

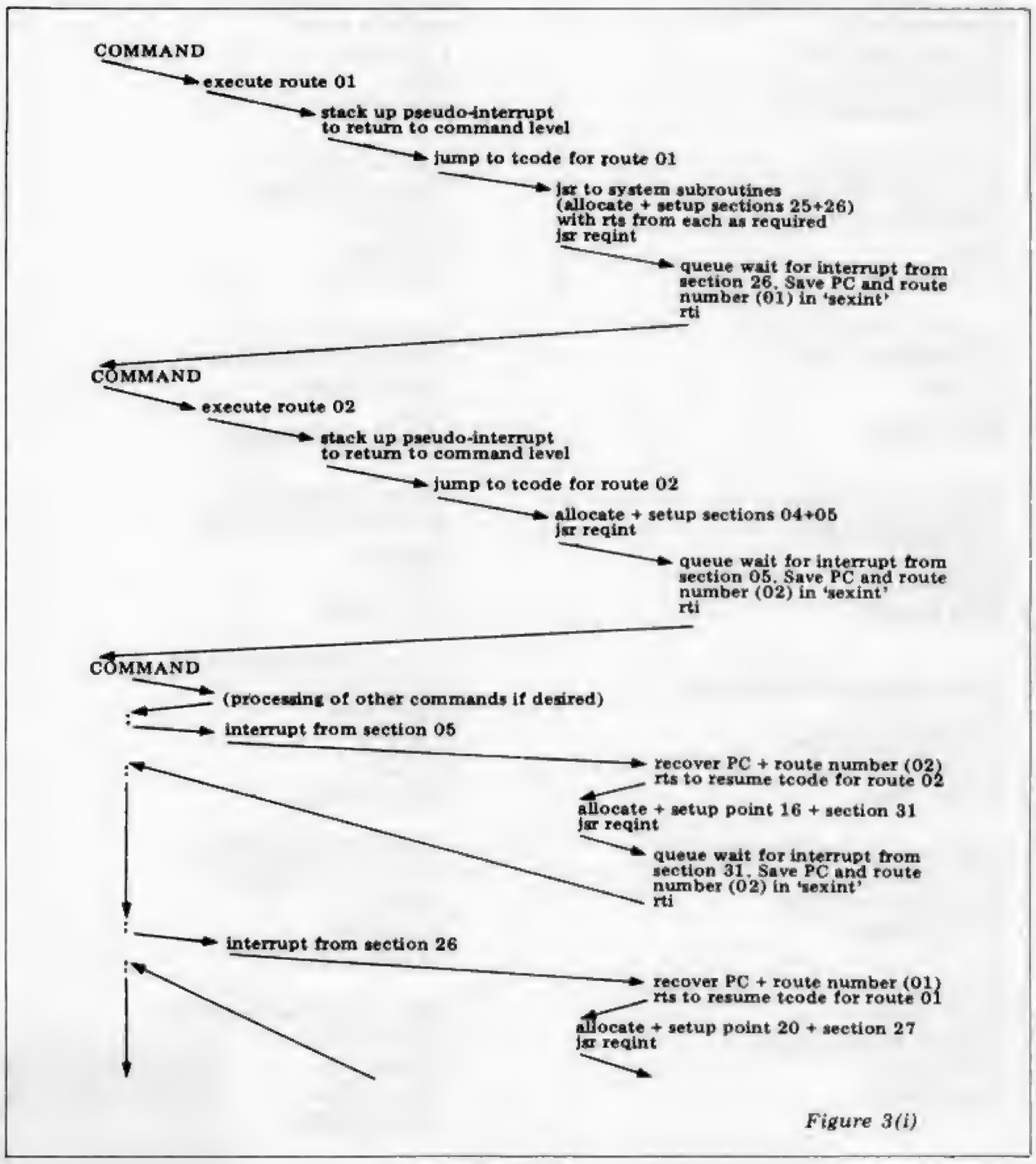


Figure 3(i)

'sexint' table. This table has an entry for each section on the layout and so when that section generates an interrupt, the task can be restarted since its route number and continue address are known.

It is obviously not possible for the processor to continue execution at the return address saved on the stack by the 'jsr' instruction, since this has now been removed. Therefore, the subroutine performs an 'rti' instruction instead. This causes the arguments placed there by the 'E' command to be unstacked and restored to the processor registers. The address placed into the program counter by this instruction just happens to be that of the Console Command Processor and so the program is now back at command input level. The only other register which needs to have a particular value is the condition code register, since it is vitally important that the interrupt mask is 'clear' so that IRQ-type interrupts are not ignored. It is now possible to obtain status reports about the layout, operate a train under manual control or even use the console as a terminal link to the PDP11/34 running UNIX further down the corridor. In fact, any of the operator command functions are possible.

The use of the 'E' command enables execution of another route task. Let us assume that the original task, which is now suspended, has a route number of '01' and we now execute route number '02' as well. An identical set of arguments is placed on the stack and the t-code for route 02 is executed. Having discovered that the train is in section 04, the task is suspended until it enters section 05. Again the 'reqint' subroutine saves the task return address and route number in the 'sexint' table but this time in the entry for section 05. The 'rti' instruction again returns the program to command input level. So, there are two tasks executing concurrently on the system, with the two trains they are controlling being driven around the layout, and the operator is again able to enter any of the 27 command functions made available to him/her by the CCP.

The train running on route 02 then enters section 05 and an interrupt is generated to inform the program of this event. The processor registers are saved on the stack and the interrupt service routine is entered. The source of the interrupt is identified and the return address obtained from section 05's entry in 'sexint' is placed on the stack. The route number (02) is also recovered from the table and the interrupt service routine performs the 'rts' instruction which resumes execution of the task at the instruction following the 'jsr reqint' call made earlier. The route task now allocates point 16 and section 31 and switches the former to drive the train through the latter. Since the 'behind' counter for this route is still less than or equal to 'minbak' because the route began in section 04, it is unable to free any resources as they are still in use. After enabling section 31 to generate an interrupt when the train reaches it, the task again calls 'reqint'. This routine saves the program counter value from the stack and the route number in 'sexint' but this time in the entry for section 31. It then performs the 'rti' instruction which, this time, is a 'proper' return from interrupt causing

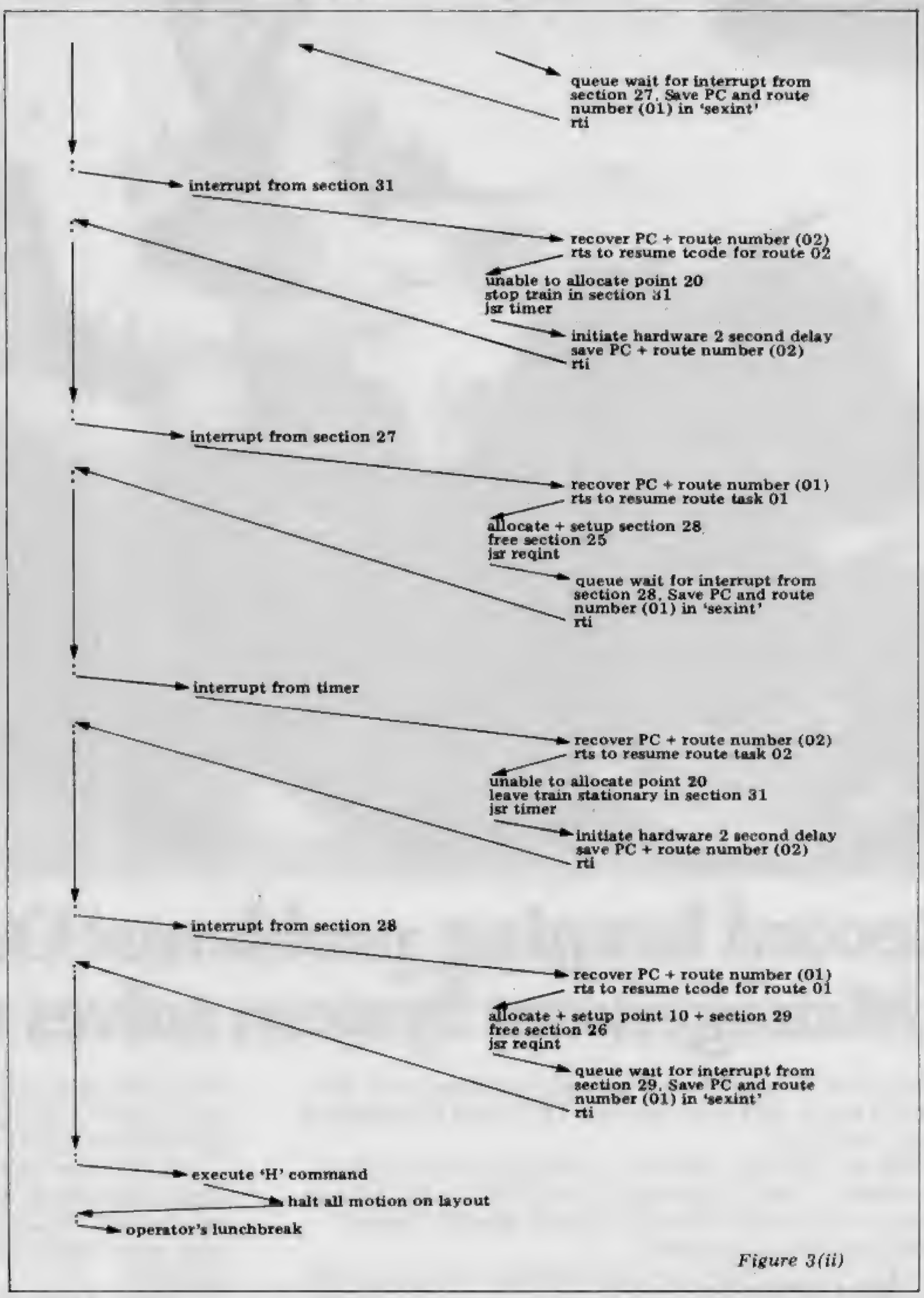


Figure 3(ii)

the processor to resume wherever it left off in the CCP.

Soon after this, the train controlled by route 01 enters section 26 and so this route task is restarted in a similar way. After allocating point 20 and section 27, they are set up to await the arrival of the train. The task is again suspended via a call to 'reqint' until the train reaches section 27.

From an outside — human — viewpoint it is clearly obvious that a collision is imminent but, as yet, the program is unaware of this approaching calamity. When the train on route 02 reaches section 31 the task is restarted in the way described above. The 'actbot' pointer into the data structure for this route informs the task that the next section it needs is point 20 and so it tries to allocate this point. However, the 'allpnt' routine discovers that this resource is not 'free', but has already been reserved by route 01 and so it returns an error signal to the task. Since it is unable to allocate this resource, the task is unable to continue with its route and so the train is stopped by setting the speed of section 31 to zero. The t-code then makes a call to the 'sleep' subroutine for a suspension of the task for two seconds. The 'sleep' routine activates one of the programmable timers on the system to provide a hardware delay of two seconds. It then removes the return address of the t-code from the stack and saves it, together with the route number ready for the eventual interrupt from the timer. The 'sleep' subroutine performs the 'rti' instruction which causes the processor to continue at the instruction that would have been executed had the section not generated an interrupt (ie inside the CCP again).

Route 01 has its task restarted again when its train enters section 27. Section 28 is free so it is allocated and set up in preparation for the train's arrival. Since the 'actmid' pointer is incremented by one section entry in the data structure, due to the train entering a new section, the 'behind' counter is also incremented. This now has the value 2 and so, in order to keep this within its limit ('minbak' = 1),the resource pointed to by the 'acttop' pointer is freed. The 'behind' counter is only decremented when a section resource is freed and so, if a point resource is freed, the process does not affect the counter. Further resource(s) must therefore be freed until it is back within its limit. In this case, since there is no point between



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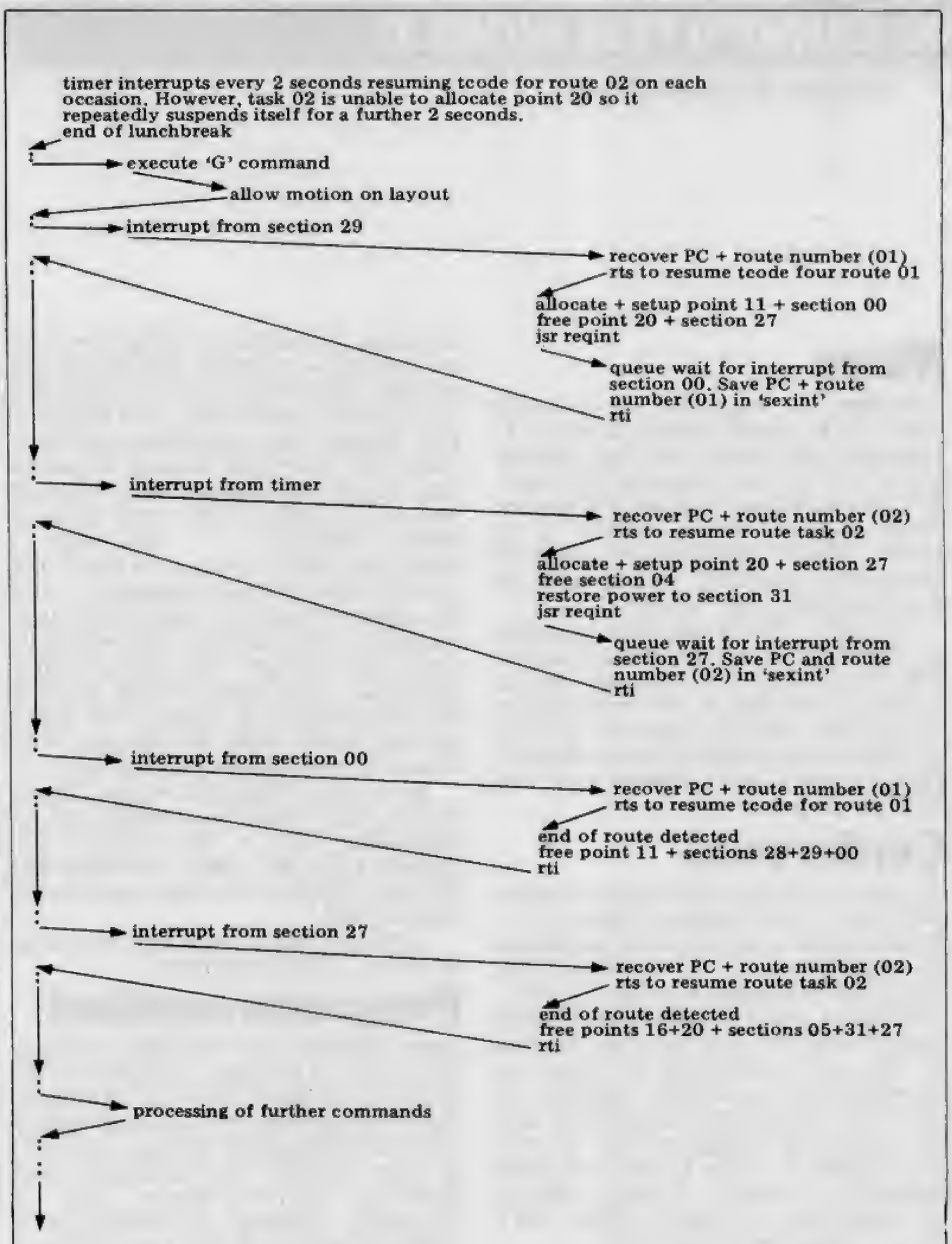


Figure 3(iii)

section 25 and 26, only section 25 is freed. The task is again suspended by a call to 'reqint' which saves the necessary resumption information in 'sexint' at the entry for section 28. The CPP code is again resumed.

After the hardware delay of two seconds has expired, the processor receives an interrupt from the programmable timer. The registers are therefore saved on the stack and the interrupt service routine for this device is run. This handler routine restacks the program counter and recovers the route number and then performs an 'rts' instruction. The task is thus restarted at the instruction following the 'jsr sleep' call made two seconds earlier. Point 20 is still busy and so the task again makes a call to 'sleep' for a further suspension of two seconds. The 'sleep' subroutine again executes the 'rti' return which effectively terminates the interrupt handler code and resumes again in the CCP.

Route 01 is resumed when the train enters section 28. Point 10 and section 29 are allocated to it and set up. It then frees section 26. Note that, because a section resource (26) is freed, the 'behind' counter is brought back to its limiting value. Point 20 is therefore still allocated to the route. The task for route 01 is then suspended by a call to 'reqint' until the train enters section 29. The processor again returns to the CCP code to await any further commands from the operator.

If the 'H' command is entered at the console all motion on the layout is halted. This means that the train on route 01 will stop in section 28 and so be unable to enter 29. This will cause point 20 to remain in a locked state, and so each time the route 02 task is restarted, it will delay for a further two seconds. Let us assume that the operator goes for lunch and doesn't enter the 'G' (or Go) command until 2½ hours later to enable the layout motion to continue. The task for route 02 will have been trying every two seconds to allocate point 20 and been suspended again after each unsuccessful attempt. The task for route 01 is still suspended, since the train has not yet entered section 29. When the 'G' command is finally entered, the train in section 28 continues on its way again and enters section 29 shortly after.

The route 01 task is then resumed and it successfully allocated point 11 and section 00. These are set up to await the arrival of the train. The route

GET ON THE RIGHT TRACK

has now finished with point 20 and so it is freed. The 'behind' counter is not decremented by this action and so the next resource, section 27, is also freed. Unlocking this section resource returns it within its limit. The task is then suspended via a call to 'reqint' until the train enters section 00.

When the programmable timer generates an interrupt to indicate the completion of yet another two second delay, the route 02 task is once more resumed in its execution. This time point 20 is free, as is section 27, and so they are successfully allocated and set up. Section 04 is freed bringing the 'behind' counter back within its limit. The power to section 31 is finally restored and the train therefore starts moving again. The task is suspended via a call to 'reqint' to await the trains arrival in section 27.

Both routes are now in their final stages, since they finish in section 27 and 00. When the train enters section 00 the t-code for route 01 discovers that the next resource it is to allocate has the value of −1. This indicates that the route has been completed and so the allocated resources are all freed. Once the necessary housekeeping has been done by the t-code, it performs the 'rti' instruction which takes the processor execution back into the CCP. This action removes the task from the execution queue and so it is no longer active.

The train on route 02 now enters section 27, its final destination section. Therefore it is stopped and all the resources currently held by the route are freed before the task aborts by performing the 'rti' instruction. The status of the system is now back again at only a single task running, that task being the Console Command Processor code waiting to process further user input commands. The two trains which originally were in sections 04 and 25 have now moved to sections 27 and 00 respectively.

All of the resources used by the routes were allocated on a first come first served basis and then freed again after use. A situation in which a collision was obviously imminent arose but was recognised by the system and safely avoided.

Summary

Microprocessors can be used to make very powerful toys for grown-up boys. However, the system described here was developed as a piece of undergraduate teaching equipment with which to put into practice some of the theory taught in the course.

The ideas discussed here are currently in use but have been put over merely as hints and suggestions. I have tried to illustrate the methods involved in such a way as to provide the basic guidelines required to develop a Real Time Control System. The purpose of that system might be anything from a comprehensive home security system to a production line. The choice is yours. . .

YOUNG COMPUTER WORLD

Compiled by Derrick Daines

Disillusioned

The young woman teacher was loud and fierce in her condemnation, her voice vibrant with contempt: 'Computers are a great big con trick!' she repeated over and over.

A month or two previously, her husband — also a teacher — had bought one of the latest generation of microcomputers and was playing with it happily, learning how to program it and put it to good use but, for her, computers were 'a great big con trick!'

The crux of her complaint was that to get the machine to do something involving an interrupt timer, it was necessary to purchase an extra chip. To be fair, she had previously been taken aback by the shortage of memory in the basic machine and her grumbles had not been too loud when they found that they needed another chip in order to do decimal arithmetic. But the interrupt timer — this was the last straw.

It is extremely difficult for newcomers to computing to find out what they're going to get for their money. Information from suppliers is mostly technical (for very good reasons) and meaningless to the tyro. His best course is to approach a knowledgeable friend but very often he doesn't know which questions to ask and assumptions are made on both sides.

My young friends are a case in point; they, of course, had never heard of an interrupt timer and, when they had approached me for advice, it had never crossed my mind that they would need one. So she had assumed that the computer would fulfil what she had in mind — and the disillusionment followed.

I can sympathise, too, with the suppliers. Not many users require an interrupt timer, an on-board real-time clock, colour graphics, relay drivers or what-have-you. So the designer makes a computer that conforms to the lowest common denominator — a basic machine to which the customers can add the facilities their needs require. Thus, in theory, all are satisfied and nobody pays for something they don't want.

In practice, things are not so easy. No supplier in his right mind advertises what his machine *doesn't* do and this leaves the door wide open for assumptions that lead to disillusionment and dissatisfaction.

There is no easy solution — indeed, one may not exist at all. One can only repeat the advice so often given — intending buyers should badger knowledgeable friends for information. Read and learn as much as you can before you buy — and then, if you're not 100 per cent sure, buy secondhand, or at the bottom end of the market. You can always trade it in later for something better.

Muse

Following my suggestion on this page that MUSE should change its name to something else, Bob Coates very quickly wrote in to say that this has been done. Bob is the Public Relations Officer for MUSE and he writes, 'MUSE is no longer called "Minicomputer Users in Secondary Education" — it is called by the four-letter word "MUSE"!'

He adds: 'MUSE has taken seriously its responsibility to the primary sector. Miss Pam Fiddy of Nanstallon School, Bodmin, Cornwall, is the co-ordinator for primary activities and we have an increasing membership from that sector.' That is good news indeed and I'm delighted to pass it on.

Conference

All primary school users should make a note now of the first-ever national conference on the use of microcomputers in the primary school, to be held at the University of Exeter, 10-12 April, 1981. This will be a very important conference indeed which no one with any interest in this area can afford to miss. An advertisement has already appeared in the *Times Educational Supplement* and the computing magazines but, in case you missed it, write to the In-Service Secretary, University of Exeter, School of Education, St Luke's, Exeter EX1 2LU, or telephone Exeter 52221.

MUSE members may like to know that Pam Fiddy will be attending and (ahem!) so will I!

Big versus many

Robert Pickering (17) of Middlesborough picked up the controversy about computer provision in school. He says that if a school or college provides one expensive machine, very few people actually get to use it and so support is low. 'On the other hand, if we decide to buy smaller, less expandable machines, there will be a large number of people who come into contact with one and feel the benefits. Then they start to think, "Perhaps ——— was right — there isn't much we can do now until our machines are fully expanded." ' (So the support exists for more and better machines.) 'Back with the first establishment who thought big; they're having problems. They need another machine but the majority are saying, "We didn't get any benefit from the first one; why should we waste money on another?" '

In a long, discursive letter, Robert makes some other good points but he concludes, 'Buy a few *simple-to-use* machines first but realise that these will almost certainly not meet your needs after a while.'

I couldn't agree more but I'm willing to listen to other arguments.

Programs received

Space Invaders for the ZX80, by Hugh Pyle (14) of Dorking; Jackpot for the ZX80, by Richard King (14) of Bristol; Maths Battleships by Richard Baldry (10) of Huntingdon; Jackpot for PET, by Gary Bartlett (14) of Bristol; Alien Shoot, by Andre Cockburn (10) of Bracknell; Animate for 6800 by N Smith of Telford, Salop; Fast 'Life' and Brooklands for TRS-80 by Robin Terry of Barking.

It was nice to hear from Andre again, who is handicapped, but, as a 6800 user myself, I had the greatest fun with N Smith's contribution. That's one thing I really like about this job — I get to play with everybody's programs!

ZX80 Space Invaders by Hugh Pyle

```
 10 DIM A(10)
 20 PRINT,"* * SPACE INVADERS * *"
 30 PRINT
 40 PRINT "APPROX HOW MANY?"
 50 INPUT F
 60 FOR Y=1 TO 10
 62 LET G=RND(10)
 64 IF NOT G > F THEN LET A(Y)=1
 66 NEXT Y
 68 LET X=1
 70 IF X >18 THEN GOTO 400
 80 FOR Y=1 TO X
 90 PRINT
100 NEXT Y
110 FOR Y=1 TO 10
120 IF A(Y)=1 THEN PRINT "*";
130 IF A(Y)=0 THEN PRINT ".";
140 NEXT Y
170 POKE 16414,0
180 POKE 16415,0
```

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Personal Computer World

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MULTI-USER SYSTEMS

After last month's introduction, Sue Eisenbach and Adrian V Stokes continue this series with an in-depth look at multi-user micro systems.

In last month's issue we looked at the concept of multi-user systems in the context of mainframes and mini-computers. A typical such computer would have a very fast processor and a limited amount of fairly fast main memory whose purchase price would far outweigh all other costs, such as peripherals, operating expenses and so on. Every effort had to be made to extract maximum work from these two items, which gave rise to the operating system which controlled all the hardware and marshalled the queues of user jobs for optimum efficiency.

In a simple batch-processing system, jobs using the same system resources (usually a compiler) are 'batched' together so that, as soon as one is finished, the next one can be started with the minimum of delay. In general, however, a complex mix of jobs is queued together so that several jobs (or segments of jobs) exist in memory at once. The operating system gives different jobs access to the processor for periods which depend on an algorithm that can take into account such factors as the relative priority of the available jobs, the amount of I/O activity and so on. The essential difference is that the processing of one job may, before it is finished, be interrupted by the operating system to allow the processor to execute another job. Once the hardware for such interrupts was available, it became possible to dispense with 'batch processing' (although this is still a very efficient way of using computer resources) and interactive systems were developed where the terminals had the ability to issue interrupts, as could any other peripheral.

Microcomputers are now evolving from single-user towards multi-user configurations. Although similar in many respects to the evolution of mainframe systems, there are, nevertheless, a number of marked differences. For one, the prices of a microprocessor and a respectable chunk of semiconductor memory are now sufficiently low that it is unnecessary to go to a great deal of effort to optimise their usage. Instead, the upmarket peripherals (such as Winchester disks, fancy printers and graph plotters) are the resources which need to be shared. We shall see how the designers of multi-user micro systems have taken note of this by providing varying hardware configurations on one or more processors.

Nevertheless, the concept of fairly sharing out (electronically-connected) facilities still involves an extension of the idea of an interrupt which can be initiated and acted upon by interconnected devices; our investigation of multi-user systems will take us as far as broadcast networks. Finally, we propose some Benchmarks which can be used to compare multi-access performance between different systems.

Classification of systems

Although virtually all multi-user systems operate by sharing expensive resources while duplicating cheap resources, this is achieved in a wide variety of ways.

To discuss these in a sensible order, it is useful to devise a classification scheme (or, as it is called in the best literature, a 'taxonomy') and a proposed scheme is shown in Figure 1.

Therefore, we can broadly divide multi-user systems into those which employ a single processor to service all the users and those for which a separate processor is associated with each user. In either case, there may be subsidiary processors — controlling the disk drives, VDU(s) or possibly a printer — but it is only the processor(s) which execute the user's own code with which we are concerned.

Single processor systems

The simplest example of a processor being required to do two jobs at once need not involve more than one user. This is called 'multi-tasking', where a processor divides its time between a normal interactive user (the 'foreground' job) and another program of lower priority (the 'background' job). One of the most common examples of this technique can be found in word-processing packages (such as Wordstar), where normal editing can occur on one file (at an admittedly slower pace) at the same time as a second file is being output to the printer.

A slightly more ambitious scheme is where a single processsor is used but additional memory is provided, beyond the normal limit of the processor. Consider the Z80 — it has a 16-bit address range which means that it can cope with a maximum 64 kbytes of memory and this is too little to share between a number of users (as well as there being no mechanism for protecting one user from another). However, memory is fairly cheap so it would be reasonable to buy, for example, 256 kbytes in a system, especially if it is possible to share this system between, say, four users. This is achieved by splitting the memory into 'banks', each of which can be the maximum addressable by the CPU (64k in this case), and assigning one bank to each user. The processor then uses 'time-slicing' whereby time is split (usually equally) between all the users into slots. During each time slot, the processor only 'sees' that user's bank of memory and so it seems that he has a dedicated Z80 processor, working at one-quarter of its speed. As a processor is idle most of the time, the degradation in performance is not likely to be nearly as dramatic as this suggests.

Several suppliers of single-user systems have bank-select multi-user systems which frequently can be obtained by expanding a single-user system (by adding memory, with the bank-select function, extra I/O ports for the additional terminals and modified software). In particular, Digital Research (which gave the world CP/M), has an operating system called MP/M, a multi-user upgrade of CP/M. Horizon also sells a bank-select upgrade for its system, as does Cromemco.

The third type of single-processor, multi-user system is that of a proper time-sharing system traditionally found on (and developed for) minicomputers and mainframes. Here, the operating system itself decides which jobs shall have which parts of memory and for how long. Jobs which are not currently active (although processing on them is not complete) are usually 'swapped-out' onto some form of backing storage such as a disk. It seems very unlikly that any 8-bit processor could cope satisfactorily with the traffic generated by such a busy operating system (nor would it have the spare capacity needed to service the operating system). However, some of the 16-bit designs (which are, effectively, mini-computers achieved with LSI technology) can be expected to offer these facilities on a scale of costs not far removed from those of a micro-computer.

Microsoft (of Basic-80, Forth-80, Cobol-80 and MxPascal fame) has signed a contract that will enable it to put a Unix (a very powerful time-sharing system originally developed at Bell Research Labs, running on PDP-11s) lookalike on the 8086, Z8000 and the

68000. Alpha Micro (and Equinox 300) has always had a time-sharing operating system available.

Multi-processor systems

The second major line of approach to multi-user systems is to provide each user with a processor and some, but not all, of the other facilities, which are provided on a shared basis.

These solutions are fairly new, first because users have only recently begun to hit the limitations of single user microprocessor systems, and, secondly, because microprocessors have dropped sufficiently in price to make it economically viable to design multiprocessor systems. The expensive parts of a micro system are the peripherals, which would certainly start with a hard disk system and may include any of a number of peripherals such as graphics terminals, plotters, digitisers and special printers, all of which are expensive.

The simplest example of this approach is to have one (master) microcomputer which is used to control traffic on a bus, into which is inserted a processor card for each user, with its own associated memory. Any I/O (including that to and from the user terminals) which occurs is dumped onto the bus and is picked up by the master processor which ensures that it (the I/O) goes to the correct destination. The snag is that, as the number of users rises, the traffic on the bus can become a bottleneck with a corresponding loss of response. Micromation has advertised that its Z system is of this design.

For a little more money it should be possible for one serial port to be associated with each user processor so that I/O to the terminal does not have to go onto the bus, which is then only used for disk transfers and more specialised I/O. This is the best of both worlds in that each user has a terminal, processor and memory — facilities which are awkward or inconvenient to share — and access to (say) 30 Mbytes of disk space or a flat-bed graph plotter when needed (with a little luck) which could never be afforded or justified on a single user's usage. From their press releases, it looks as if Intertec (of SuperBrain fame) and RML (380Z) are designing multiprocessor systems using this type of 'star' configuration.

Finally, a new group of systems is appearing on the market in which costly or exotic peripherals may be shared, while, at the same time, participating machines in the network may communicate with each other independently of any central controller. Examples currently available are Nestar and Econet. Nestar allows up to 65 Apples to be connected with one of the machines acting as a server for a particular peripheral. In the Nestar system this 'server' machine would be dedicated to, say, file handling. The Econet system allows up to 255 Acorn Atoms to be connected to a network in a similar fashion to the Nestar system, except that the machine containing the 'server' program can be running another program at the same time and is interrupted while the appropriate service is performed. This system can be described as a 'broadcast network'.

The users are not usually connected by anything as sophisticated as a bus. Instead, a parallel or even serial cable is used to connect the computers together. Complex networking protocols are required to ensure that data moves smoothly from point to point without bottlenecks or interference. Such a system is very close in concept to the large-scale networks which have been developed to link mainframe computers together.

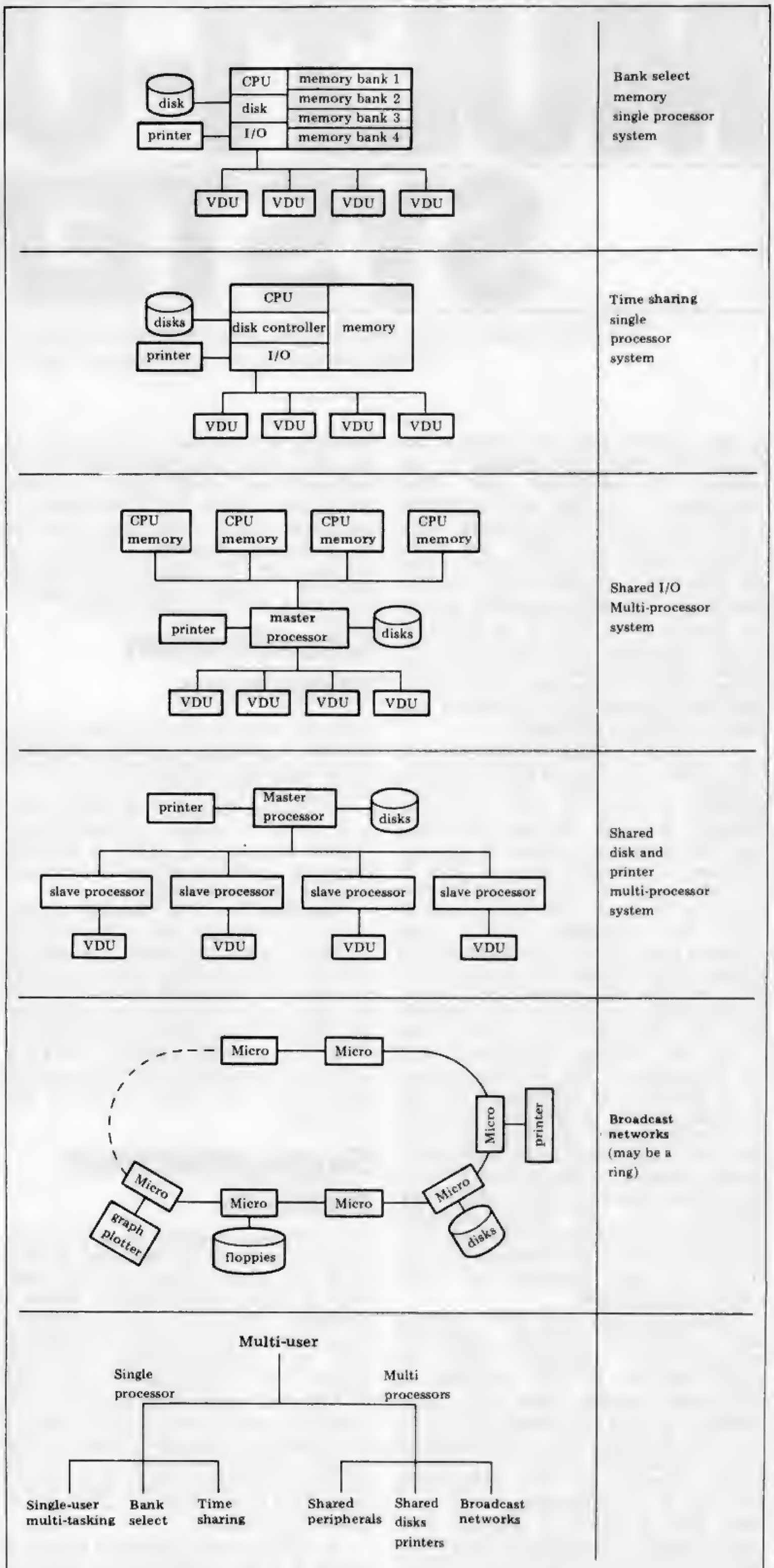


Fig 1 Hierarchy of multi-user systems

Benchmarks

On a single-user computer system, Benchmark programs are used to test the speed of a variety of commonly-performed operations. On a multi-user system, the user does not have access to the full resources of the computer. And so, even though it may be interesting to ascertain how fast a given machine can execute a program when only one user is on the system, this gives little indication of how the system will respond when it is fully used. What is interesting is the extent of degradation of performance caused by additional users on the system.

The level of degradation depends on the amount of stress a given task places on the shared resources of a system. We have decided to limit our tests to a maximum of four users on one machine. Looking at the multi-user systems available now, many seem to cater for this number. There are some systems (and these are primarily in the 'network' category), which will allow a far larger number (for example, 64) than two reviewers can borrow or test — a large number of monkeys would be helpful. More importantly, most trends as to how a given system is likely to deteriorate should be apparent by the time four users are on the system.

Each test will be run four times. The first time, the program will be run by one user, the second time by two, then by three and finally by four. For each run, every user will be timed independently in order to see how evenly the resources are spread.

The tests are designed specifically to test the processor, I/O and disk capabilities. They will be written in Basic unless a system does not have this language, in which case they will be translated into a language supported by the system. Fortunately, the language (and whether it is compiled or interpreted) is not important since the programs are designed to compare single and multi-user performances with each other, rather than with some absolute measure. Listings of the four tests in a pseudo-Basic are given.

The first program is intended to test the level of degradation to the response time of a processor-bound job. For this test, the Basic Benchmark 7 will be used as it contains a range of processor activities with minimal I/O and no traffic to and from the disks.

It is expected that a computer system based on a single processor would run (N+overheads) times as slow when N users are on the system, compared with timings for a single user. Not only does the processor have to execute the same job N times but it is also responsible for scheduling the jobs. On a bank-select, single processor system, this overhead should be minimal (it is usually performed mainly by hardware, with the processor having to merely save current registers, then execute a single instruction to change banks). On a time-shared system, where user programs are swapped to and from the disks, an operating system may need a significant amount of time for executing its routimes.

It is on this test that multi-processor systems should score most favourably. There should be no noticeable deterioration as additional users are added to the system.

The second test is designed to test the independence of I/O to the user's console. The printable character set is displayed on the screen 100 times. There is no input as this depends on the user's typing speed and, hence, is subject to wide variations. Confining the test to output only should not affect the validity of the test since it is difficult to think of a reasonable configuration where input and output are handled very differently.

For this task, the actual timing of a single user will be dependent on the speed of the VDU and so the relevant data will be the comparison of this time with that when two, three or four users are on the system. Systems which show a noticeable increase in time taken would not be suitable for I/O-bound tasks. This test should prove most interesting for multi-processor systems where I/O is controlled by a master processor.

The third test is designed to place stress on the disk filing system. A file (the same one for all of the users) is written to and read from 100 times. Before each access, the file is opened and after each access it is closed. It will be interesting to see how single-processor systems compare with multi-processor systems on this type of test. As most of the processing time is spent in disk transfers, there shouldn't be a great deal of difference between the two types of system. It will also be interesting to see how networks compare with the multi-processor systems.

Whereas test three opened and closed its file for every disk access (requiring access to the directory each time), the final test opens a file, writes 100 records, then closes the file; this is followed by an open, 100 reads and a close. This is a test of the system software rather than the hardware. One of the problems of a multi-user operating system is that it has to cope with keeping files from being corrupted when two or more users wish to access them concurrently. On the simplest of systems, corruption of data will occur when two users write to the same record at the same time (MU-PET sales literature specifically warns potential customers of this difficulty). The easiest way to overcome this is to ensure that once a file has been opened on a disk by one user, no other user can write to that disk until the first user has closed his file (that is, protection at the disk level). This is a very drastic solution which certainly overcomes the problem but, for applications which make heavy use of the disk, is untenable. The second solution is to ensure that only one user at a time writes to a file but that other files on the same disk have unrestricted access (ie provide protection at the directory level). This is the system generally used in mainframes. It should be noted that anyone can read from a file which has been opened for writing, but the results are not guaranteed. The ideal solution would be to provide protection at the record level, but this is quite a complex method. However, this is a software problem and there shouldn't be any correlation between hardware configurations and response times.

Since writing the first article on multi-user systems, numerous such systems have been announced or have become available. We hope that we have described the different types of system in enough detail that potential users will be able to decide which type of system is appropriate for a given application. Over the next few months, we will Benchtest several of these systems, using the Benchmarks described here.

Multi-User Benchmarks

```
        The Processor Test
        --- --------- ----

        PRINT "S"
        K = 0
        DIM M(5)
500     K = K + 1
        A = K/2*3+4-5
        GOSUB 820
        FOR L = 1 TO 5
           M(L) = A
        NEXT L
        IF K < 1000 THEN 500
        PRINT "E"
820     RETURN
        END
```

```
        The Disk Access Test
        --- ---- ------ ----

        PRINT "S"
        create file
        fill 128 byte record
        FOR I = 1 TO 100
          open file
           write record
           close file
        NEXT I
        FOR I = 1 TO 100
           open file
           read record
           close file
        NEXT I
        PRINT "E"
        END
```

```
The Disk Access Software Test
--- ---- ------ -------- ----

PRINT "S"
create file
fill 128 byte record
open file
FOR I = 1 TO 100
   write record
NEXT I
close file
OPEN FILE
FOR I = 1 TO 100
   read record
NEXT I
close file
PRINT "E"
END
```

```
        The Input/Output Test
        --- ----- ------ ----

        PRINT "S"
        FOR I = 1 TO 100
           FOR J = 32 TO 96
              PRINT CHR$(J) ;
           NEXT J
           PRINT
        NEXT I
        PRINT "E"
        END
```

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ZX80 PRINTER

To supplement Peter Faff's 'Printerfacing' series, Dr C J Ogle has sent this simple circuit to add a serial printer to the ZX80, something we know will be of immense interest to those ZX80 owners who can't wait for 'Uncle' Clive to produce an 'official' printer.

To operate a serial printer, you must first convert the data in 'byte' format inside the computer into a series of electrical potentials or currents representing a start bit, data bits in least significant to most significant bit order, a parity bit and one or more stop bits. The timing of these pulses depends on the baud rate used by the printer — see Figure 1.

In designing this interface for the ZX80, I considered two methods for this conversion:

1. Using a UART chip to convert the data presented to it on seven parallel data lines into the required serial format;
2. Using a machine code program in the ZX80 to perform the necessary conversions and output the data along one data line (D0).

Both methods have their advantages and disadvantages. If you use a UART, the data to be printed, after conversion to the appropriate ASCII format, need only be POKEd to the address at which the UART is located. While the character is being transmitted by the UART, the next character can be prepared for transmission. However, to weigh against these advantages is the need to provide the correct timing clock for the UART and also the interconnection of seven data lines.

The second method has the advantage that, while data is being transmitted, no other processing can be carried out but it has the advantage of simpler interconnections (only one data line is used) and the use of less sophisticated (and therefore cheaper) hardware. This second method has been developed into a working system for the ZX80 and is described here. It can be broken down into three distinct components:

1. Hardware interface to the printer;
2. Machine code program to provide timing and to output data to the printer;
3. Basic program to enter machine code program and to convert characters to ASCII format and send them to the m/c program for printing.

Hardware interface

The circuit for this is shown in Figure 2. It takes data in from data line D0 (edge connector A4 on the ZX80) and latches it, using the 7474 when AX is high and DE (device enable) is low. The source of the signals AX and DE will depend on whether the ZX80 has the Sinclair memory expansion pack or not.

With the expansion pack, DE can be obtained from pin 11 of the 74138 decoding chip on the expansion board. This can be brought out to pin B23 on the board as this pin is not connected in the computer; the track connecting the pin to ground will need cutting. IF AX is connected to address line A0 (pin B7), then the printer is apparently located at all odd numbered addresses between 5001H and 53FFH.



Fig 1 Serial data format. The duration of each bit is (1/baud rate) seconds.

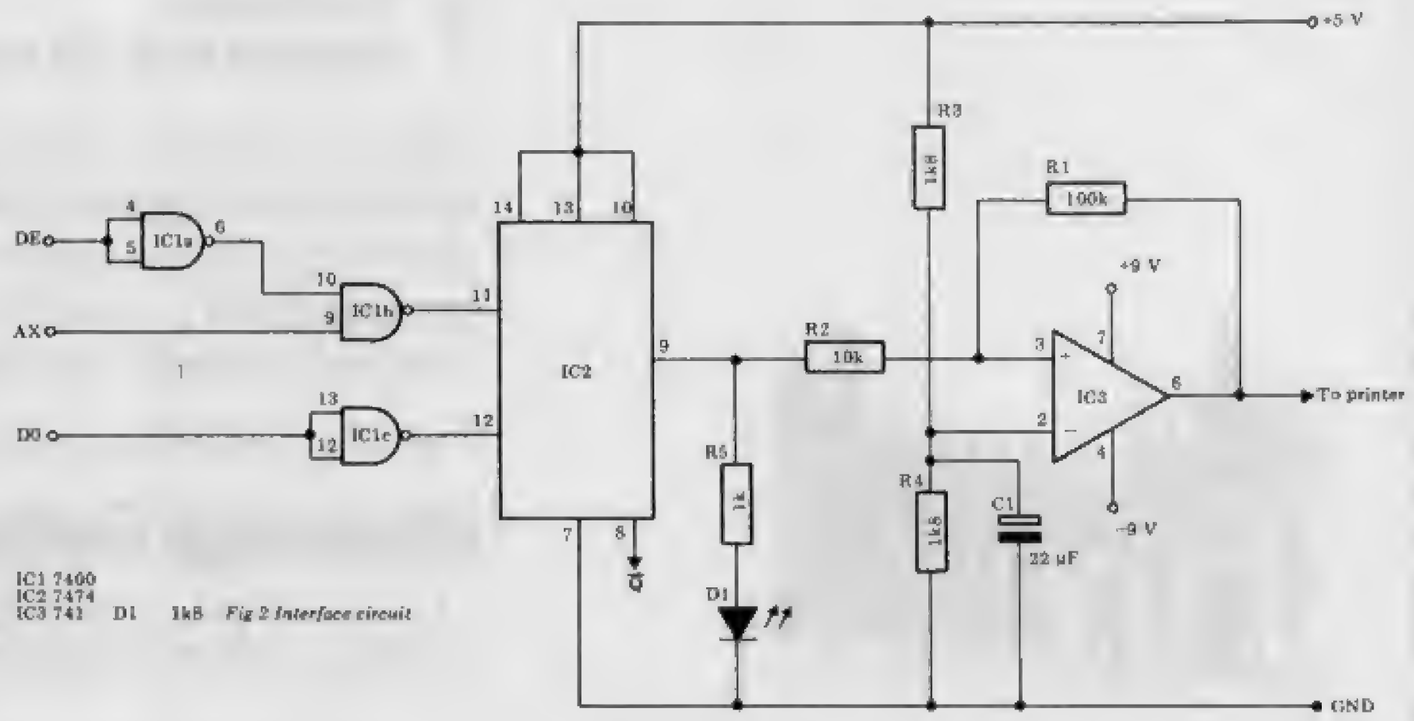


Fig 2 Interface circuit

If an unexpanded ZX80 is being used then DE can be WR (pin A17) and AX can be A12 (pin A14). In this case, the printer is located at 1000H to 1FFFH and at alternate blocks of 1000H upwards to FFFFH. My ZX80 has an expansion board and address 5001H (20480 decimal) has been used to access the printer.

The remainder of the circuit uses a 741 op amp to convert the 0 V (mark level) and +5 V (space level) from the 7474 to −9 V and +9 V required by the printer used. The LED — D1 — is used only as an indicator; it can be turned on by POKEing 0 to the printer address (5001H or 1000H as above) and turned off by POKEing 1 to that address.

The +9 V and −9 V supply for the 741 can be provided by two 9 V (PP3) batteries if an additional power supply is not available. Pin B1 provides +5 V and pins B4 and B5 are ground.

If your printer uses conventional +5 V and 0 V logic levels, then these are available from the Q output of the 7474. The provision of a 20 mA current loop would require some amplification of the 741 output and a 'beefier' power source than the two PP3s.

Machine code routine

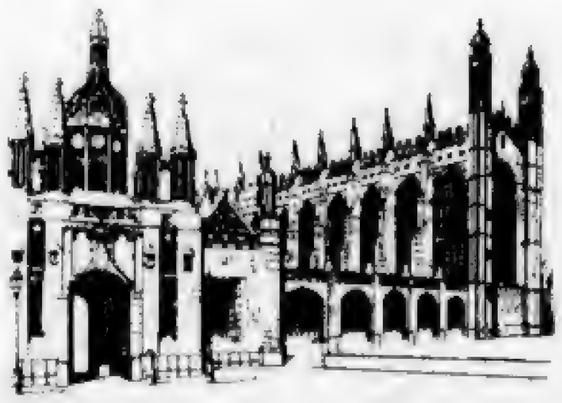
This is quite short and is shown in Listing 1. The character to be printed — CHAR — is checked for parity and the parity bit is set if neccessary. A start bit (00) is sent to the printer address and then a delay loop is

```
21 01 50          LD   HL,5001      ;PRINTER ADDRESS
3E 00             LD   A,CHAR       ;LOAD CHARACTER
E6 7F             AND  7FH          ;BIT 7=0
F5                PUSH AF           ;SWAP FLAG REGISTER -
D1                POP  DE           ;INTO E
CB 53             BIT  2,E          ;AND CHECK PARITY
20 02             JR   NZ,PART
F6 80             OR   80H          ;SET PARITY BIT IF NECESSARY
37          PART  SCF               ;CARRY WILL BE STOP BIT
CB 17             RLA
16 0A             LD   D,10         ;BIT COUNTER
36 00             LD   (HL),00      ;SEND START BIT
18 02             JR   DELAY
1F          DATA  RRA               ;NEXT BIT INTO '0' POSITION
77                LD   (HL),A       ;AND SEND
0E 08       DELAY LD   C,L1         ;OUTER LOOP COUNTER
06 17       LOOP1 LD   B,L2         ;INNER LOOP COUNTER
10 FE       LOOP2 DJNZ LOOP2
0D                DEC  C
20 F9             JR   NZ,LOOP1
15                DEC  D
20 F2             JR   NZ,DATA      ;GO FOR NEXT BIT
C9                RET               ;RETURN IF DONE
```

Listing 1 Assembler language listing of printer subroutine

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entered, the length of which is determined by the values of L1 and L2. The character bits are then sent one at a time, starting with the least significant bit, the delay loop being entered between each bit. Finally a stop bit (01) is sent.

Basic program

The program in Listing 2 does what it claims — it prints its own lisiting — but it can also print anything (except graphic characters) which is PRINTed in a program.

It uses the machine code routine described above which is stored in array A(). This method of machine code storage has three main advantages:
1. Any code can be used (the suggestion has appeared elsewhere of using REM statements for M/C routines. This is not very satisfactory as some codes can make the system 'hang');
2. The code is easily entered using INPUT statements and is retained when the program is SAVEd;
3. The contents of the array relocate themselves when lines are added to or deleted from a program and cannot be overwritten by the display area.

The starting address of the variable storage area is held in memory locations 16392 and 16393 (VARS) and if the array A() is DIMed before any other variables are used then the elements of the array are stored in pairs of adjacent addresses from VARS+2 upwards. One point to note is that numerical variables are stored with their low byte first, eg 255 decimal is stored as FF00.

The numbers to be entered into array A() are given in Table 1. This is for 1200 baud and the values for other baud rates are given in Table 2. When the program is run, the values are typed in response to the prompt showing the array member being entered. A second arrray, B(), holds 18 members of a look-up table used to convert the non alpha-numeric characters into ASCII. Again the values of B() are given in Table 1 and are entered as for A().

AT this point the program STOPs and it is as well to save it as, if any errors have been made in entering the machine code routine, the program may well crash. Having saved the program, it can be listed on the printer by entering GOTO 9900. The routine located here gets the program line contents from its location in memory, converts the line number (held in binary form) into decimal and then PRINTs the line, character by character. Doing this automatically converts the tokens for PRINT, GOTO, REM, etc, into their full form. When the end of line character (76H — variable Q) is met, subroutine 30 is called. This routine first calculates the location of the start of array space (OUCH) and then the start of display space (S). The characters that have been sent for display by the print statements are then PEEKed one at a time and converted to ASCII format, letters and numbers being converted by the addition of 27 and 20 respectively to their code values. Other printable characters are given a value between 1 and 17 and these are converted to ASCII using array B(). Graphic characters are converted to ASCII 32 (space) from B(0).

The ASCII value is held in variable A which is transferred in subroutine 20 to the location CHAR in the machine code routine which is then called by the statement in line 24. The character is then printed.

Having printed the listing, the program again STOPs. The use of the program for general printing is shown by entering GOTO 1000.

In general, anything that is PRINTed in a program can be output to a printer by using GOSUB 30 in a following statement. Note, however, that as it stands, the program will insert carriage returns and line feeds at the end of a printing call and not at the ends of display lines (this allows for full use of paper width). It recognises the end of display by two NEWLINE characters inserted at the beginning of subroutine 30 (PRINT in lines 34 and 36). At the end of the printing routine there is a clear screen statement which allows as many lines of subsequent printing as desired without the computer running out of display space.

Non-printable control characters such as Form Feed (ASCII 12) or TAB (ASCII 9) can be sent to the printer by LETing A= the desired value and GOSUBing to 20.

To use this program as a printing and listing part of another, it can be LOADed and the additional program entered between lines 200 and 9000 but note that the program so written will have to be run using a GOTO statement, as RUN will clear the arrays. Again the CLEAR statement cannot be used for the same reason but this is a small penalty to pay for this powerful printing facility.

If you are short of memory space, then after first running the program and filling the arrays, lines 100 to 160 can be erased without destroying the value of the variables created by them.

Baud rate	L1	L2	A(13)	A(14)
110	88 (58H)	23 (17H)	22542	5894
150	64 (40H)	23 (17H)	16398	5894
200	48 (30H)	23 (17H)	12302	5894
300	32 (20H)	23 (17H)	8206	5894
600	16 (10H)	23 (17H)	4110	5894
1200	8 (08H)	23 (17H)	2062	5894
2400	4 (04H)	23 (17H)	1038	5894
9600	1 (01H)	21 (15H)	270	5382

Table 2

Contents of arrays A and B for 1200 baud rate, even parity.

A(0)	289	B(0)	32
A(1)	15952	B(1)	34
A(2)	-6646	B(2)	35
A(3)	-2689	B(3)	36
A(4)	-13359	B(4)	58
A(5)	8275	B(5)	63
A(6)	-2558	B(6)	40
A(7)	14208	B(7)	41
A(8)	6091	B(8)	45
A(9)	2582	B(9)	43
A(10)	54	B(10)	42
A(11)	536	B(11)	47
A(12)	30495	B(12)	61
A(13)	2062	B(13)	62
A(14)	5894	B(14)	60
A(15)	-496	B(15)	59
A(16)	8205	B(16)	44
A(17)	5625	B(17)	46
A(18)	-3552		
A(19)	201		
A(20)	0		

Table 1

```
1 REM *** A PROGRAM TO PRINT ITS OWN LISTING
2 REM *** FOR THE ZX80
3 REM *** BY C.J.OGLE
4 REM *** IF ARRAYS HAVE BEEN FILLED
5 REM *** GOTO 9900 WILL LIST TO PRINTER
10 GO TO 100
20 REM CALL M/C ROUTINE TO OUTPUT TO PRINTER
22 POKE OUCH+4,A
24 LET X=USR(OUCH)
26 RETURN
30 REM GET CHARACTER FROM DISPLAY AND CONVERT TO ASCII
32 LET OUCH=PEEK(D-5)+256*PEEK(D-4)+2
34 PRINT
36 PRINT
38 LET S=256*PEEK(D)+PEEK(D-1)
40 LET S=S+1
42 LET CD=PEEK(S)
44 IF CD=Q AND PEEK(S+1)=Q THEN GO TO 64
46 IF CD=Q THEN GO TO 40
48 LET A=CD
50 IF A>1 THEN LET A=A-10
52 IF A>17 THEN LET A=A+30-
54 IF A>57 THEN LET A=A+7
56 IF A<0 THEN LET A=0
58 IF A<18 THEN LET A=B(A)
60 GO SUB 20
62 GO TO 40
64 LET A=13
66 GO SUB 20
68 LET A=10
70 GO SUB 20
72 CLS
74 RETURN
100 DIM A(20)
105 DIM B(17)
110 FOR I=0 TO 20
115 PRINT "ENTER A(";I;")"
120 INPUT A(I)
122 CLS
125 NEXT I
130 FOR I=0 TO 17
135 PRINT "ENTER B(";I;")"
140 INPUT B(I)
142 CLS
145 NEXT I
```

GOTO page 144

Listing 2

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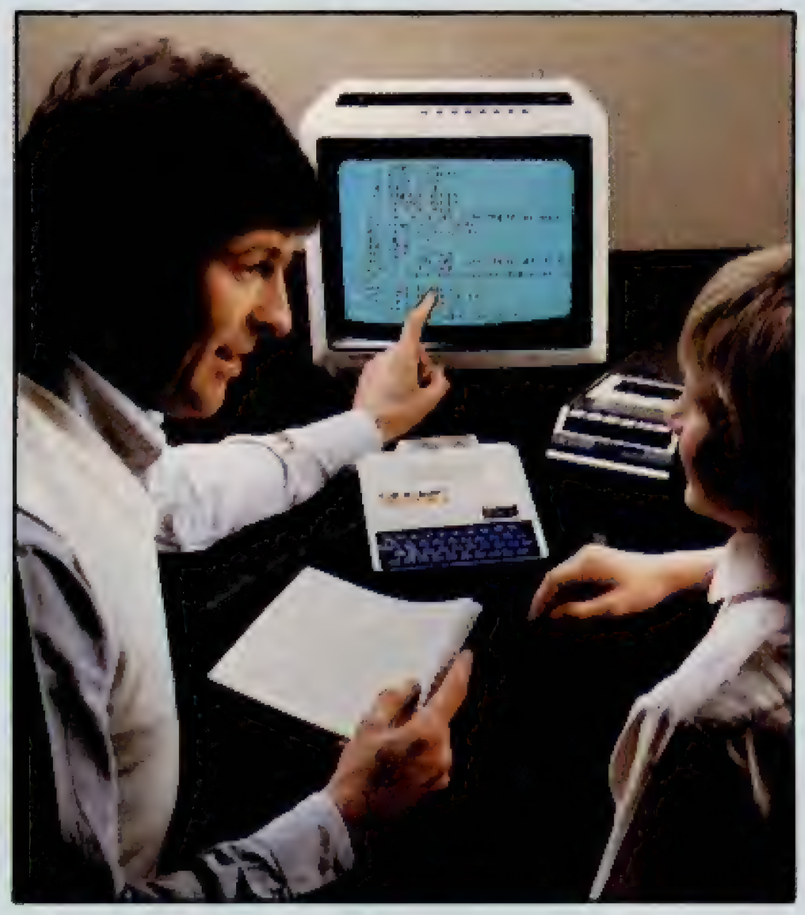
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MY INTEREST IS:.....

MICRO CHESS

by Kevin O'Connell

MICRO BITES MAN!

For the first time in the history of chess, a computer will be taking part in an official international event intended primarily for humans. From 21 February to 1 March, Hong Kong will be playing host to the 3rd Asian Cities Team Championship. At least 26 teams, containing many chess masters, will be competing, including three each from Malaysia, Thailand, Indonesia, India and China, two each from Pakistan, Papua New Guinea and Japan and one each from Singapore, Brunei, Sri Lanka and Hong Kong.

The tournament will be partially sponsored by SciSys-W Ltd, which is one of the world's leading manufacturers of chess computers. This Hong Kong company will be entering a team of four of its own computers, called the Chess Champion Mark V, and chess experts are predicting that the computers will cause a number of surprises in the event.

If this competition is a great success, it is possible that the World Chess Federation (FIDE) might decide to allow computers to participate in the biennial World Team Championship.

The Chess Champion Mark V, as a warm-up for the Hong Kong event, played in the important annual tournament in Islington, London in December. I cannot show you any games from that event since it didn't start until a few days after the deadline for this article. Instead I offer you the following game, played last November, in which an earlier version of the program bit the hand that feeds it. For added interest, I include the notes written by the programmer immediately after the game (notes in italics are my additions).

White: Chess Champion Mark V
Black: Programmer

This game started off as a test of new features but quickly developed into a challenge I was not willing to give up.

1	d2-d4	d7-d5
2	Ng1-f3	c7-c5

I was willing to give up the pawn in the hope that it would try to hang on to it — which it did! Then I was supposed to prove that this was unwise. Trouble was, I'd forgotten the details, except that one tries to undermine the c-pawn somehow with the a-pawn.

3	d4xc5	e7-e6

This is probably too early. Nb8-c6 would be better, or even a7-a5 first. Getting the pawn back with Qd8-a5+ would have defeated my object.

4	b2-b4	a7-a5
5	c2-c3	Nb8-a6
6	e2-e3	

All my moves are bad and Chess Champion Mark V is proving it to me.

6	...	a5xb4
7	Bf1-b5+	

I think Chess Champion Mark V played only two weak moves in this game and this was one.

7	...	Bc8-d7
8	Bb5xa6	b7xa6
9	c3xb4	Ng8-f6
10	0-0(e1-g1)	Bf8-e7
11	Nb1-c3	0-0 (e8-g8)
12	Nf3-e5	Qd8-c7
13	Qd1-d4	Rf8-c8

I'm still hoping to undermine the c-pawn.

14	Bc1-d2	Bd7-e8

I had thought of bringing the knight to d7 to challenge the knight on e5 and also be able to play f7-f6.

15	a2-a4!	

It's either now or never. . .

15	...	a6-a5
16	Nc3-b5	Be8xb5
17	a4xb5	a5xb4
18	Ra1xa8	Rc8xa8
19	Bd2xb4	Nf6-e8

Nf6-d7 is not so good now and I must do something quickly before these pawns get too far advanced. By this time I had given up hopes of winning.

20	b5-b6	Qc7-c8

Where else?

21	Rf1-c1	

Interesting. I had expected Rf1-b1. This allows me to play Ne8-d6.

21	...	f7-f6
22	Ne5-f3	Ne8-d6
23	c5-c6	

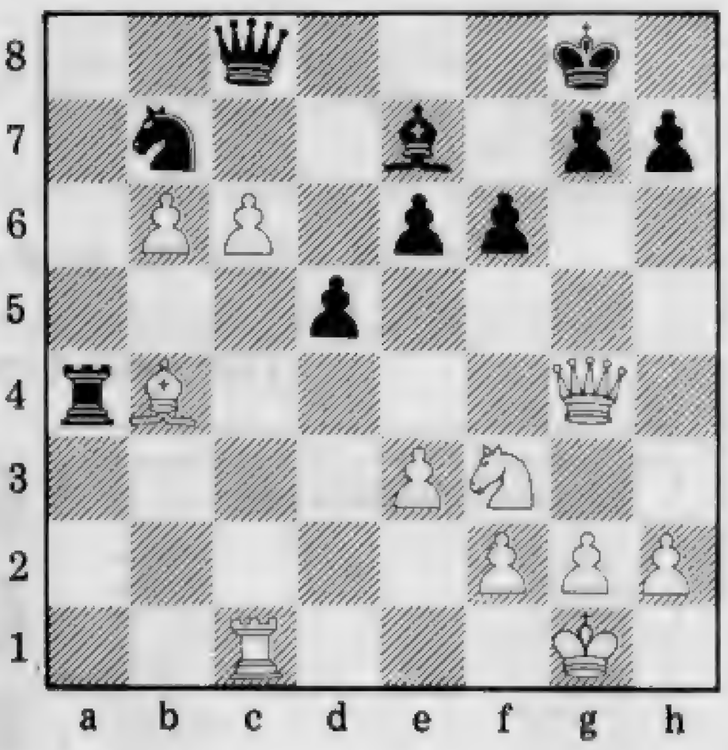
I expected this, of course, and thought I had a way out.

23	...	Ra8-a4
24	Qd4-g4?	

This was the other weak move, though it turned out to be good in the long term. However, I thought I had won material with my next move.

24	...	Nd6-b7!

Yes?



25	Nf3-e1!	

No! Very good indeed. *The idea is that if 25 . . . Be7xb5 then 26 c6xb7! Qc8xb7 27 Qg4xe6+ and 28 Rc1-c8+.*

25 . . . Nb7-a5

26	b6-b7!	

Chess Champion Mark V now knows it can win material — at least a piece. In fact, it is impossible to avoid complete defeat now, so I resigned.

26	...	1-0

Do you think that game is impressive? I do. The programmer's chess rating is about 1700 on the international scale, which means that he is in the select one percent or so of chess players who are (or were!) stronger than the best of the chess micros. It will certainly be interesting to see what happens in the Asian Cities Team Championship and I will keep you posted.

Writing for PCW

PCW welcomes approaches from would-be writers, even those who may never have appeared in print before. In this game it is often those with practical experience who have important things to say so we don't mind too much if their prose is less than perfect. Providing that submissions have a sensible structure and follow a logical sequence, we can take care of the polishing. Here are some tips:

If the article is already written, simply send it in, making sure that your name, address and 'phone number appear on both the article and the covering letter. If you have submitted the same work to other magazines you should tell us — it would be embarrassing (to say the least) if the same article appeared in more than one.

If you have an idea for an article or a series, write us a letter outlining your ideas. A one or two page synopsis giving the proposed structure, sequence and content will give us a sound basis for discussion. Please give us a 'phone number if possible.

If you have nothing specific in mind but feel qualified to conduct case studies, benchtests or whatever then drop us a line saying what you'd like to do and why you think you're qualified to do it. We're not particularly looking for strings of academic qualifications — experience carries just as much weight.

Dick Pountain is always on the lookout for interesting calculator features and we wouldn't mind seeing one or two readers getting on their soapboxes but remember: even articles such as this need a structure.

Reading *PCW* will give you a good idea of the style we prefer. You may notice that we try to avoid pomposity at one extreme and flippancy at the other (except in 'Chip Chat', that is).

Finally, have a look through back issue indexes and try not to re-invent any wheels. Oh, we almost forgot — *PCW* does pay for all published work.

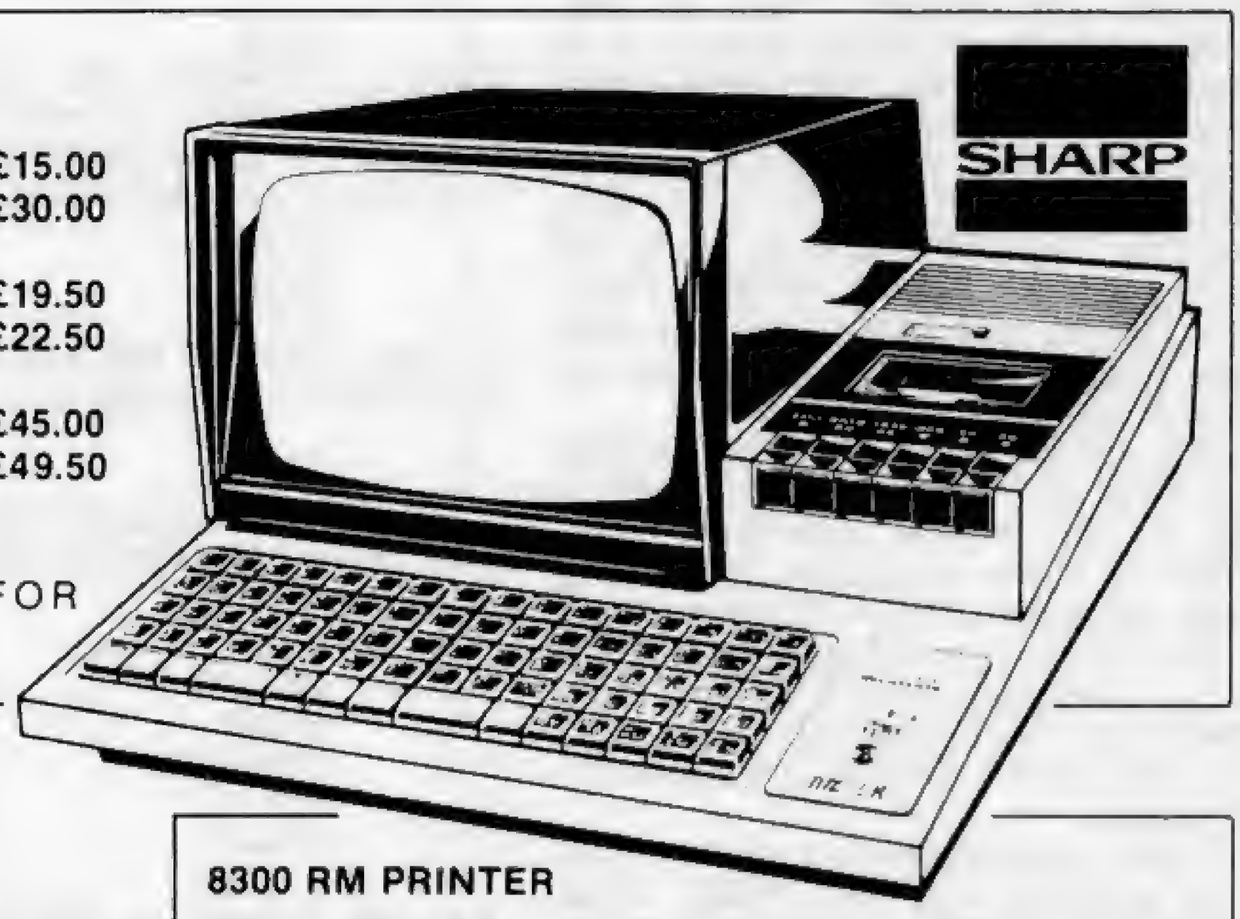
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NEWCOMERS-START HERE

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in PCW. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, *PCW* will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, *processing* it, storing the results or sending them somewhere else. All this information is called *data* and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in 'human' form, inside it's a different story — they must be held in the form of an electronic code. This code is called *binary* — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or *bits* as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being *ASCII* (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a *byte* and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called *hex*. The hex equivalent of a byte is obtained by giving each half a single character code (0—9,A—F): 0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101 . . . . . E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in *memory* as bytes. The rules are called *programs* and while they can be input in binary or hex (*machine code* programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the *programming language* is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is *Basic*. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To *run* such a program the computer uses an *interpreter* which picks up each English-type *instruction*, translates it into machine code and then feeds it into the *processor* for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are *PEEK* and *POKE*. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to *hardware*, this means the physical components of a computer system as opposed to *software* — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (*CPU*), a single microprocessor chip with supporting devices such as *buffers*, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board *(PCB)* or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a *bus system* is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the *S100*.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, *RAM* (Random Access Memory) and *ROM* (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — *static* and *dynamic*; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called *PROMs* (Programmable ROMs) and *EPROMs* (Eraseable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, *cassettes* and *floppy disks* are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a *read/write head* across the disk's surface. The disk is divided into concentric rings called *tracks*, each of which is in turn subdivided into *sectors*. Using a program called a *disk operating system*, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: *soft sectoring* where special signals are recorded on the surface and *hard sectoring* where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the *stringy floppy* — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. *Hard disk* systems are also available for microcomputers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit *(VDU)*, which looks like a TV screen with a typewriter-style *keyboard*; sometimes these are built into the system, sometimes they're separate. If you want a written record *(hard copy)* of the computer's output, you'll need a *printer*.

The computer can send out and receive information in two forms — *parallel* and *serial*. Parallel input/output *(I/O)* requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the *baud rate* and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is *RS232* (or *V24)* while, for parallel interfaces to printers, the *Centronics* standard is popular.

Finally, a *modem* connects a computer, via a serial interface, to the telephone system allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's permission; instead you could use an *acoustic coupler*, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — British Telecom isn't so uppity about the use of these.

IN STORE

DIRECT ACCESS

There are several interesting new entries this month, from the low-cost Atari, with its range of superb video games, to the up-market Onyx, a hard disk-based business system. Note that both of them use tape cartridges for removable memory. Other additions include the Sharp PC3200, the Tandberg TG 3450, and a new British machine, the Gemini 801. Icarus, main distributors of the Superbrain, have moved and their new phone number is 01-485 5574. Finally, C Itoh and Manhattan Skyline are, at time of press, completing arrangements for joint distribution of the SBS 8000. Send updates for 'In Store' to me, **Dick Olney,** *at* **PCW, 14 Rathbone Place, London W1P 1 DE.**

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
ABC 80 (£738)	Datormark Ltd: 09322 44896	16-40k RAM; Z80A; C; 12", 16x40 b&w VDU; 4680 bus; IEEE 488; RS232 port.	DOS; Basic (16k ROM); *Fortran; Pascal; A; Multi user Basic.*	Colour video graphics with UHF output. Viewdata compatible. Loudspeaker. Numeric keypad. Options: dual 5¼" F/D (320k) £895; dual 8" F/D (2 Mb). BT 1/80. (I)
ACT System 800 (£3950)	ACT: 021-455 9898 (50)	48k RAM; 6502; dual 5¼" F/D (800k); 12", 30x64 VDU; 1 S/P; 1 P/P; Multi-screen int.	MDOS; Basic; A; *CBasic; PL/M; Forth; Fifth; Cesil; Pilot; Fortran.*	IBM compatible K/B. High resolution graphics. Available with dual 8" F/D (2.4 Mb) £4950 — 4.8 Mb maximum. BT 2/80 (E).
Alpha Micro (£5650)	Alpha Micro (UK) Ltd: 01-250 1616 (TBA)	64k — 1 Mb RAM; 16 bit; dual 8" F/D (2.4 Mb); 6 S/P.	Multi-user OS; Basic; M/A; Pascal; U.	Modular. Expands to 1200 Mb, 24 terminals or multiprocessor system. (E)
Altos ACS 8000 (£3398)	Logitek: 02572 66803 (33)	64k RAM; Z80; 1k EPROM; dual 8" F/D (1Mb); 2xRS232 ports; 1 P/P.	CP/M; *Basic; CBasic; Cobol; Pascal; Fortran.*	Expandable to 4-user system with 58Mb H/D. Maintenance contracts avail; BT 5/80 (S&H).
Apple II (£695)	Microsense: 0442 41191 (190)	16-48k RAM; 6502; 8 I/O slots.	O/S; Basic; *Pascal; Fortran.*	280x192 high resultion graphics; Integer Basic in 6k ROM; Option: single 5¼" F/D (116k) £349.
Atari 400 (£395-16k)	Ingersoll: 01-226 1200 (TBA)	8-16k RAM; 6502; C int; cartridge slot; 12 x 20 TV int; RS232C port; touchpad k/b; Opt: C £55.	OS (10k ROM); Basic (8k ROM).	High resolution colour graphics. 4-channel sound. Four games controller/light pen sockets. BT 10/80. (I/B)
Atari 800 (£695-16k)	As above.	8-48k RAM; 6502; C int; 4 x cartridge slots; 12 x 20 TV int; RS232C port. Opt: single 5¼" F/D (90k) £525; 16k RAM £145.	As above.	As above. Software & RAM on cartridge modules. Up to 4 disk drives. BT 10/80. (I/B)
Athena 8285 (£5694)	Butel-Comco Ltd: 0703 39890 (TBA)	64k RAM; 8085A; dual 5¼" F/D (644k); 12", 25x80 VDU; 150 cps printer; RS232 port.	AMOS; T/E; Basic; *Cobol; Fortran; Pascal; APL; M/A.*	Extended ASCII K/B with numeric pad; graphics. Options: dual 8" F/D (2Mb); up to 1200 Mb H/D
Atom (£120)	Acorn: 0223 312772 (N/A)	2-11k RAM; 6502; Full K/B; C int; TV int; 20 I/O lines; 1 P/P.	Basic in 8k ROM; A; Cass O/S.	High resolution graphics on bigger model; colour monitor O/P. Loudspeaker. Note also, systems based on Acorn SBC. BT 7/80 (B).
Attache System II (£8000)	Friargrove Systems Ltd: 01-572 3784 (10)	64k RAM; Z80; dual 8" F/D (1.2Mb); 12", 24x80 VDU; 180 cps printer.	Basic; *Fortran; Cobol.*	Upgradable to multiuser system with 34Mb H/D. Full range of business packages included software dealers TBA. (S).
BASF 7120 (£5155)	BASF: 01-388 4200 (TBA)	64k RAM; Z80A; 3 x 5¼" F/D (480k); 12", 24 x 80 VDU; RS232 port; P/P.	DOS; *Ex Basic; Cobol U.*	H/D available soon. Also 7110 with dual F/D £4275. Disk controller has own Z80A. BT 9/80. (I)
Billings BC-12 FD: (£3995)	Mitech: 04862 23131 (TBA)	64k RAM; Z80A; dual 5¼" F/D (640k); 12", 24x80 b&w (or b&g) VDU.	DOS; Basic; *Fortran; Cobol; A.*	With dual 8" F/D (2Mb) £5995. Additional dual 8" F/D £3000. (S).
C/09 (£3975)	SWTP Ltd: 01-491 7507 (16)	56k RAM; 6809; dual 8" F/D (2Mb); 8", 16x80 VDU; 1 S/P.	TSC FLEX; *Basic; Pascal; A; Dis A; T/E; U.*	VDU is intelligent. Option: 15Mb H/D £3575; with dual 5¼" F/D (350k) instead of 8", £3000. (H)
Canon BX-1 (£3850)	Canon Business Machines (UK) Ltd: 01-680 7700.	64k RAM; 6800; Single 5¼" F/D (65k); 12"; 25 x 80 VDU; 5 x V24 ports.	DOS; Ex Basic; A.	Also supplied with integral thermal printer instead of VDU. (S&H)
Challenger 1P & C4P (£220 & £395)	CTS: 0706 79332. Millbank Computing: 01-549 7262. Mutek: 0225 743289. U-Microcomputers: 0925 54117 (18)	4-32k RAM; 6502; C int; RS232 port. Options: dual 5¼" F/D (160k) £550; for C4P dual 8" F/D (1.15Mb) and 20MB H/D.	O/S; Basic (8k ROM) *Ex Basic*; A.	D/A conv; colour capability. Runs OSI business software on 8" F/D Plato educational software avail. soon. BT 4/80. (S).
Challenger 2 (£1500)	As above	48k RAM; 6502; dual 8" F/D (0.5Mb); RS232 port.	OS65U; Ex Basic; A.	Designed as low cost business system (S).
Challenger C3 (£2334)	As above	32-56k RAM; 6502; 6800; Z80; dual 8" F/D (1.15Mb); 2-16 S/P.	OS65U; Basic; *CP/M; Fortran; Cobol.*	Expandable to multi-user (8) system. Options: C3B & C3C H/D units, 74Mb for about £8500. (S&H).
Clenlo Conqueror System B (£1950	Clenlo Computing Systems Ltd: 01-670 4202 (TBA)	64k RAM; Z80; dual 8" F/D (1Mb); 3 S/P; 2 P/P.	CP/M; CBasic-2; Pearl 1; *U.*	With four 8" F/D £2850. (S&H)
Clenlo Conqueror System D (£5150)	As above	64k RAM; single 8" F/D (500k); 10Mb H/D; 3 S/P; 2 P/P.	CP/M; CBasic-2; Pearl 11; *U.*	With 26Mb H/D and no F/D £5950.

List of Abbreviations

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C	Cassette	H	Hardware	N/P	Numeric pad	TBA	To be announced
E	Extensive	H/D	Hard disk	O/S	Operating system	U	Utility
		I	Introductory	P/P	Parallel port		
		Int	Interface	S	Software		

Please note: Software items listed in *italic* are not included in the basic price of the equipment. All prices are *exclusive* of VAT.

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Compucolor II (£995)	Dyad Developments: 08446 729 (TBA)	8-32k RAM; 8080; 13" 32x64 8-colour VDU; single 5¼" F/D (51k); RS232 port.	DOS (ROM); Ex-Basic (ROM); A.	16k version £1078, 32k £1198. High resolution graphics. 6-month subscription to user magazine inclusive BT 9/79. (S)
Compucorp 625 (£6000)	Compucorp: 01-952 7860 (17)	48-60k RAM; Z80; dual 5¼" F/D (630k); 9", 16x80 VDU; 40 col printer; RS232 port, P/P.	Basic; A; *Fortran; Pascal;* U.	IEEE-488 Controller and S100 int. Many applications packages avail. (E)
Compucorp 655/ 665/675 (from £5895)	As above	60k RAM; Z80; Up to 4 x 5¼" F/D (160k-2.4Mb); 9", 20 x 80 or 12", 20 x 80 or 20", 60 x 80 VDU; 40-col printer; RS232 port.	As above	Prices incl installation and training. Opt: 10-20Mb H/D
Computermart 2000 DS (£1500)	Computermart: 0603 615089	32-256k RAM; 8085; dual 8" F/D (1-2Mb); S/P; P/P.	CP/M; *Cis Cobol; Basic; Fortran.*	Expandable to multi-user, multi-tasking, multi-processor 96Mb H/D system (around £15000).
Cromemco System 2, System 3, System Z2H. (£2100/ £3730/£5340)	Datron: 0742 585490. Comart: 0480 215005. MicroCentre: 031 556 7354 (18)	64k RAM; Z80; dual 5¼" F/D (346k) on System 2 & Z2H; dual 8" F/D (1.2Mb) on Sys 3; 10Mb H/D on Z2H; S/P; P/P.	CDOS; *Basic; Cobol; Fortran; RPG II; Lisp; A; W/P; Multi-user Basic.*	All systems expandable to multi-user (max 7) £6408 Sys 2, £8304 Sys 3. Options: dual 8" F/D (996k); 11-22Mb H/D. BT 10/79 (E).
DAI (£998-48k)	Data Applications (UK): 0285 2588 (TBA)	12-48k RAM; 8080; C int; 24x 60 VDU int; RS232 port; over 20 industrial ints.	Basic (ROM); U.	Colour graphics up to 255x 335; 3 notes & noise generator; PAL O/P to TV; Paddle int; H maths option. (I). BT 10/80
Diablo 3000 (£8960)	Business Computers Ltd: 01-207 3344 (TBA)	32k RAM; 8085; dual 8" F/D (1.2Mb); 12", 24x80 b&w VDU; 45cps printer.	DOS; Basic; DACL; A; U.	Selection of business packages included (S).
Digital Microsystems DSC-2 (£3525)	Modata: 0892 41555 (10)	64k RAM; Z80; dual 8" F/D (1.14Mb); 4xRS232 ports; EIA port.	CP/M; Basic-E; CBasic; *Cobol; Fortran; Pascal.*	14 or 28Mb H/D available or additional F/D units (H).
Digital Microsystems DSC-4 (£6045)	As above	128k RAM; Z80A; single 8" F/D (500k); 11Mb H/D; 4x RS232 ports; 2 P/P.	CP/M; Basic-E; CBasic; *Cobol; Fortran; Pascal.*	Also DSC-3 with 64k RAM. Options: 128k RAM £1295; up to 4Mb F/D and 29Mb H/D. (H).
Durango F-85 (£7500)	Comp Ancillaries: 0784 36455 (12)	64k RAM; 8085; dual 5¼" F/D (1Mb); 9", 16x64 green VDU; 132 col 165 cps printer; N/P.	O/S; DBasic; *CP/M; CBasic; Micro Cobol.*	Up to 5 work stations; fully integrated system. Options: additional dual 5¼" F/D (1Mb); 12-24Mb H/D. (S).
Dynabyte 5200-5900 £2300	Metrotech 0895-57780 (15)	64k RAM; Z80; S100 bus; 2 ser ports; 1 par port; any com of 5¼" F/D (1.2Mb) 9/27/45 Mb H/D, 32/64/96Mb Cart Module Disk.	CP/Net, CBasic, MBasic Cobol, Fortran, Pascal, PL/1-80.	All systems expandable to Multi-user and networking; CP/M inc in base price for F/D systmes, MP/M for H/D systems.
Equinox 200 (£7500)	Equinox: 01-739 2387 (N/A)	64-512k RAM; Z80; 10Mb-1200Mb H/D; 6 x S/P; 1 P/P.	CP/M; CBasic; *Cobol; Fortran.*	Multi-user MVT/FAMOS available in place of CP/M. 16-bit version (Equinox 300) £10,000. (S&H).
Euroc (£7995)	Euroc: 01-729 4555 (TBA)	64k RAM; 8080A; dual 8" F/D (1Mb); 15", 25x80 b&w VDU; 132 col 140 cps printer.	CP/M; CBasic; A; U.	Financial software available. Supply of stationary included.
Executive Minicomputer (£378)	Binatone Int: 01-903 5211 (N/A)	16k RAM: Z80; 500 bps C; 32x64 TV int; extra C int; 1 P/P.	Basic (12k ROM); M/A; *Fortran.*	Graphics avail. F/D under development. Also 4k version called 'Oxford minicomputer'.
Exidy Sorcerer (£749)	Liveport Data Products: 0736 798157 (27)	16-48k RAM; Z80; RS232 port; 1 P/P; S100 connector; 30x64 VDU int.	O/S: Basic (ROM); *T/E; A; CP/M; Algol; Fortran; Basic; 80.*	High resolution graphics capability; user programmable character set. 32k version £799; 48k £849. Option: single 5¼" F/D (315k) £600.
Gemini 801 (£1075)	Gemini: 02403 22307 (7).	64k RAM; Z80A; Single 5¼" F/D (315k); 25 x 80 VDU int; RS232 port. P/P.	CP/M; *Basic; Cobol; Fortran; Pascal; A; T/E.*	Up to two integral & two external F/D. Graphics. With no F/D and C int, £750. (S)
Haywood 3000 (£2022)	Haywood: 65 28301. (TBA)	48k RAM; Z80A; dual 5¼" F/D (800k); RS232 port; P/P. Opt: 15", 28 x 80 VDU £799.	CP/M; *Basic; Cobol; Fortran; Pascal; W/P.*	Also system 7000 with 48-65k RAM and 8" F/D (2.5Mb) £2999. (S)
HP 85 (£1830)	Hewlett Packard Ltd: 0734 784774 (16)	16-32k RAM; C.P.U.; 5", 16x32 VDU; C (200k): 64 cps printer; 4 P/P. Options: dual 5¼" F/D (540k) £1408; dual 8" F/D (2.4Mb) £3744.	Basic (ROM)	Full dot matrix graphics. Complete range of interfaces, peripherals and application packages avail. 16k RAM £222. (S).
IMS 5000 (£1500)	Equinox: 01-739 2387 (20)	16-56k RAM; Z80; dual 5¼" F/D (320k); 2 x S/P; 1 P/P.	CP/M; CBasic; *Cobol, Fortran.*	3 drives option: (S&H).
IMS 8000 (£2500)	As above	64-256k RAM; Z80; dual 8" F/D (1Mb); 2 x S/P; 1 P/P	CP/M; CBasic; *Cobol; Fortran; MicroCobol.*	Multi-user MVT/FAMOS available in place of CP/M. (S&H).
ITT 2020 (£867)	ITT: 0268 3040 (15)	16-48k RAM; 6502	Monitor; A; ExBasic; Dis A.	360x192 high res graphics. ExBasic in 6k ROM: Options — single 5¼" F/D (116k), £425; 16k RAM, £110; RS232 port, £96: 32k system, £931: 48k system, £995. (B).
Ithaca DPS1 (£3995)	Ithaca: 01-341 2447 (10).	64k RAM; Z80; dual 8" F/D 1Mb); 2 x RS232 ports; 4 x P/P. Opt: H/D.	CP/M; *Basic; Cobol; Fortran; Pascal; A; U.*	Z8000 16-bit processor board avail. soon. IEEE/S100 (8 or 16 bit) compatible. (E)
LX-500 (£3500)	Logabax Ltd: 01-965 0061 (13)	32k RAM; Z80; dual 5¼" F/D (180k); 12" 25x80 b&w VDU; 100cps printer.	DOS; Basic; A.	Other printers available. (S).

List of Abbreviations

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IN STORE

DIRECT ACCESS

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
LSI M-One (£5995)	LSI Computers 04862 23411 (20)	8k RAM; 8080; dual 8" F/D (1.2Mb); 12", 24x80 b&w VDU.	FMOS; A.	Choice of standard business packages included in price. (S).
LSI M-One Model 5. (£9900)	As above	16k RAM; 8080; dual 8" F/D (2.4Mb); 2x12", 24x80 VDUs; 120 cps bidirectional printer.	FMOS; A.	One VDU is for inquiry only. (S).
Macro 1 & 2 (£3750 or £280 pm).	Micro APL Ltd. 01-834 2687 (TBA)	64k RAM; Z80; dual 8" F/D (1 Mb); 4xRS232 ports.	CP/M; APL; U; *Basic; Fortran; Cobol; Word-star Algol; Pascal; Forth.*	Designed as timesharing replacement. (S).
Megamicro (£6080)	Bytronix: 0252 726814 (5)	56k RAM; Z80; dual 8" F/D (500k); 12", 20x80 green VDU; 180 cps printer; 2 S/P; 2 P/P.	CP/M; U; *Basic; A; M/A.*	Range of bus. packages now avail. from Ludhouse of Streatham. (H&B).
Micro Trainer 1 (£650)	Hewart: 0625 22030 (N/A).	16-32k RAM; 6800/6809; 10" 16 x 64 VDU; 2 x C int; Opt: dual 5¼" F/D (160k) £595; 8k RAM £17.	Basic; A; *Pascal; PL/M; W/P.*	SS50-based system. Graphics avail. Int card with real time clock £17. (I)
Mikro 1000 (£3950)	Airamco: 0294 57755 (TBA)	64k RAM; Z80; dual 8" F/D (1Mb); 12", 24x80 VDU; S100; RS232; 1 P/P.	CP/M; Basic; Cobol; Fortran.	Also word processor with 44 special function keys & NEC Spinwriter printer £4450. (S&H)
Microstar 45 Plus (£4800)	Data Efficiency Ltd: 0442 63561 (30)	64k RAM; 8085; dual 8" F/D (1.2Mb); 3 S/P; RS232 port.	Stardos; CP/M; Basic; Cobol; Fortran.	(E).
Microtan 65 (£69)	Tangerine: 0353 3633 (6)	1k RAM; 6502; TV-int; Exp up to 277k RAM.	1k TANBUG monitor; 2k A, disassembler, cassette firmware; *10k Microsoft ExBasic.*	Options: bulk I/O modules, hi-def colour graphics, DOS, system racking, ASCII keyboard. (S&H)
Millbank Sys 10 (£2995)	Millbank: 01-788 1083 (6).	65k RAM; Z80; dual 5¼" F/D (700k); 12", 24 x 80 VDU; 2 x RS232 ports; RS449 port; P/P.	CP/M; *Basic; Cobol; Fortran; Pascal; PL1; W/P.*	One high level lang. included. 12-month warranty. Main-frame comm. package. H/D avail. soon. (S&H)
MS5001 (£8250)	BMG Ltd: 0793 37813 (N/A)	64k RAM; 8085; dual 8" F/D (1Mb); 12", 80x24 VDU; 160 cps printer; RS232.	CP/M; *Basic; Cobol; Fortran; MP/M.*	Price includes desk mounting and one computer. Hardware & software support. Leasing arrangements available. (E)
MSI 6816 (£1200)	Strumech: 05433 4321 (5)	16-56k RAM; 6800; 9" 16x64 b&w VDU; C int; 1 S/P; 1 P/P.	Basic; A.	Graphics & PROM programmer available. (S&H).
MSI System 7 (£3500)	As above	56k RAM; 6800; dual 5¼" F/D (160k); 9", 16x64 VDU; 1 S/P; 1 P/P.	FDOS; Basic; A; U.	As above. Multi-user O/S avail. Options: 10Mb H/D.
MSI System 12 (£8000)	As above	56-184k RAM; 6800; 10Mb H/D; 9", 16x24 VDU; 1 S/P; 1 P/P.	SDOS; Basic; CBasic; U.	As above. Business packages avail. (H & S).
Nanocomputer NBZ80S (£420)	Midwich: 0284 701321	4k RAM; 2k ROM; Z80; C int; 8 digit LED; Calc K/B; RS232 port; 2 P/P.	Machine language; *Basic; A; T/E.*	Designed for hardware education. Full training manuals included. Fully expandable. (E).
Newbrain MB £219	Newbury Labs. 021-707 7170. Newbear. 0635 30505 (N/A)	2-4k RAM; Z80A; Nat 420; 14x 16 VDU; 2xC int; TV int; V24 port. Option: C (50k) £60.	C Basic (16k ROM)	Graphics. Battery or mains. Mains only with 16k RAM £269. (low power battery version £299). (I).
North Star Horizon (£2230)	Comart: (7) 0480 215005. Comma: 0277 811131. Equinox: 01-739 2387 (20)	48-56k RAM; Z80A; dual 5¼" F/D (360k); 15", 24x80 VDU; 150cps printer; 2 S/P; 1 P/P.	DOS; Basic; CP/M; *Cobol; Fortran; Pascal.*	With 32k and single F/D £1495. Options: 18Mb H/D.
Onyx C8000 (£6850)	Onyx Dist Ltd: 0734 664345 (TBA)	64k RAM; Z80; 12Mb Cartridge; 10Mb H/D; RS232 port; P/P.	CP/M; *Basic; Cobol; Fortran; Pascal; W/P.*	C8001 with 128k RAM £8220. Multi-user version avail. using Oasis. (E)
Panasonic JD 800U, JD 840U (£4275, £4950)	Panasonic Business Equipment: 01-262 3121 (10 regional dist)	56k RAM; 8085A; 2-4k PROM; dual 8" F/D, JD800 U (500k), JD840U (2Mb); 12", 24x80 green VDU; 3xRS232 ports.	CP/M; Basic; *Micro-Cobol.*	Also available with 5¼" F/D; JD740U (570k) £4095. BT 3/80 (S).
Pascal Microengine (£2295)	Pronto Electronic Systems Ltd: 01-554 6222	64k RAM; MCP 1600; 2x RS232 ports; 2 P/P.	Pascal.	CPU instruction set is P-code; no interpreter needed. Available with dual 8" F/D (2Mb) £3900.
Periflex 630/64 (from £1995)	Sintrom: 0734 85464 (5)	64k RAM; Z80; dual 5¼" F/D (630k); 2xRS232 ports; 1 P/P.	CP/M; *Basic; Fortran; Cobol; A.*	One-day installation training on site included in price. Option: dual 5¼" F/D (630k) £859; dual 8¼" F/D (1Mb) £1025. BT 6/80 (S&H).
Periflex 1024/64 (from £2750)	As above	64k RAM; Z80; dual 8" F/D (1.2Mb); 2xRS232 ports; 1 P/P.	As above.	As above.
PET 8k, 16k, & 32k (£450, £550, £695)	Commodore: 01-388 5702 (150)	8-32k RAM; 6502; C; 9", 25x40 VDU; IEEE-488 port; Options: dual 5¼" F/D (353k) £695; same but (950k) £895.	O/S; Basic (in 8k ROM); *Forth; Pilot; Pascal.*	Disk controller for 8k version £30. New 8032 with 80-col screen (32k). BT 12/80. £895. (I).
Powerhouse 2 (£1125)	Powerhouse Micros: 0422 48422 (TBA)	32-64k RAM; Z80A; 5", 29x96 VDU; RS232 port; external bus.	4k Monitor; *FDOS; Basic; ExBasic (14k EPROM)*	VDU has flexible screen logic. Options: FDOS & Basic £210; graphics card £200. (H)
Powerhouse 3 (£2600)	As above	32-64k RAM; Z80A; dual 5¼" F/D (350k); 5", 29x96 VDU; RS232 port; external bus.	As above.	VDU as above. With 1.2Mb F/D £3500. ExBasic & FDOS in 14k EPOMs £300. (H)
Rair Black Box (£2250)	Rair: 01-836 4663 (N/A)	32-64k RAM; 8085; dual 5¼" F/D (260k); 2x RS232 ports.	CP/M; Basic; Cobol; Fortran; M/A.	16k RAM expansion £250 10Mb H/D £2500.

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Research Machines 380Z (£1123)	Research Machines 0865 49791 (N/A)	16-56k RAM; Z80A; 2xC; RS232 port.	ExBasic; A; T/E; U; *CP/M; Fortran; Cobol; Algol; Cesil.*	Limited graphics. Many possible systems. With 48k RAM & dual 8" FD (1Mb) £3394.
S/09 (£5350)	SWTP Ltd: 01-491 7507 (16)	128k RAM; 6809; dual 8" F/D (2Mb); 8", 21x92 VDU; 2xS/P; 1 P/P.	TSC FLEX; *Basic; Pascal; A; Dis A; T/E; U.*	VDU is intelligent. Expands to 60Mb H/D multi-user system. Option: 15Mb H/D £3575. Maintenance contracts. (S&H).
SBS 8000 (£1449)	Manhattan Skyline Ltd: 08012 3442; C Itoh 01-353 6090 (TBA)	64k RAM; Z80A; 12", 16x64 VDU; 1 P/P; RS232 port (extra £133).	ExBasic (24k ROM); *DOS.*	Options: disk control card £237; dual 5¼" F/D (368k) £795; dual 8" F/D (2Mb) £1400. BT 11/80. (S)
SEED System 1 (£2000)	Strumech: 05433 4321 (4)	32-64k RAM; 6800; dual 5¼" F/D (160k); 9", 16x24 VDU; RS232 port.	DOS; Basic; U; *Fortran; A; Pilot; Strubal; T/E.*	Several F/D options. With 64k RAM & dual 8" F/D (1.2Mb) about £3000. (E).
Sharp MZ-80k (£480) (22)	Sharp electronics (UK) Ltd: 061-205 2333 (22)	6-34k RAM; Z80; C; 10", 24x 40 VDU; Option: dual 5¼" F/D (280k) £780.	Basic (14k ROM); A.	Graphics; loudspeaker. 18k RAM version £529; 22k £549; 34k £599. BT 10/79 (B).
Sharp PC3200 (£2995)	As above	64k RAM; Z80A; dual 5¼" F/D (500k); C int; 12", 25 x 80 VDU; 70 lpm printer.	DOS; U; Basic.	CP/M may be avail. next year. Various expansion cards avail. (I&B)
Sinclair ZX80 (£100)	Science of Cambridge: 0223 311488 (N/A)	1-16k RAM; Z80A; C int; TV int; full K/B; 44-pin expansion port.	Basic (4k ROM).	Kit £80. Mains adaptor £9. (S).
Smoke Signal Chieftan (£1807)	Systems Implementation Ltd: 06924 5666 (TBA)	32-64k RAM; 6800/6809; dual 5¼" F/D (160k); 12", 24x80 VDU; RS232 port.	DOS; *68/FLEX; Basic; Fortran; Cobol; U.*	With dual 8" F/D (2Mb) £2712. Designed as development system for industrial control. (H)
Solitaire WP & BS200 (£6750 & £8200)	Solitaire KPG: 01-995 3573 (TBA)	64k RAM; 8085; 14" VDU (with own CPU); 45 cps printer; CPU port; dual 5¼" F/D (700k) 8" F/D (1.02Mb) with BS200.	DOS; Basic., dual	All solitaire systems are compatible; graphics on 11x13 dot matrix.(S).
Sord M100 (£795)	Midas Computer Services Ltd: 0903 814523 Exleigh Bus. Mach. 0736-66577. (8)	48k RAM; Z80; 8k ROM; 12", 24x64 green VDU; RS232 port; S100 bus; N/P.	O/S; Basic; *A; Fortran; Pascal.*	M100 ACE with single 5¼" F/D (143k) £1850. Up to 3 drives possible. Colour graphics avail. (I).
Sord M223 Mk II-VI (£3950)	As above	64k RAM; Z80; 8k ROM; single 5¼" F/D (350k); 12", 24x80 green VDU; RS232 ports; S100 bus; N/P.	O/S; ExBasic; *CBasic; Multi-User Basic; Fortran; Pascal; Cobol.*	Expandable to 4Mb F/D, 32Mb, H/D, 5 screens, 2 printers. M243 with 192k RAM & dual 8" F/D £7000.
SPC/1 (£3770) (TBA)	Digital Data: 01-573 8854	64-1024k RAM; 8085A-2; dual 5¼" F/D (90k); 12", 24x80 VDU; 2xRS232 ports; Option: single 8" F/D (1Mb) £1090: 20Mb H/D £7000.	Mikados; Comal; Pascal; A.	With 32k RAM and single F/D (Comal only) £1995. Expandable to multi-user system (8 users). BT 7/80 (S).
Superbrain (£1995)	Icarus: 01-485 5574 (TBA)	64k RAM; 2xZ80; dual 5¼" F/D (320k); 12", 25x80 VDU; S100 bus; RS232 port.	CP/M; A; *Basic; Cobol; Fortran; APL; Pascal.*	Limited graphics. Mainframe int avail. Full range of application packages avail. Opt: dual 5¼" F/D (320k); dual 8" F/D (2.4Mb); 8-120Mb H/D. BT 8/80. (S&H).
System 80 (£1355-48k)	Nascom: 02405 75155 (32)	16-48k RAM: Z80A; dual 5¼" F/D (560k); TV int; RS232 port.	CP/M; Basic (8k ROM).	EPROM firmware avail. Colour graphics card £165. Many configurations possible. (S&H).
Tandberg EC10 (£4000)	Tandberg: 0532 774844 (N/A)	64k RAM; 8080A; single 8" F/D (250k); 12", 25x80 VDU; 7x RS232 ports; printer int.	CP/M; ExBasic (24k) *Multi-user Basic; Pascal; Cobol;* A; U;	Up to 7 terminals. Includes V28 comms port. (S & H).
Tandberg TG 3450 (£2200)	As above	64k RAM; 8085; single 5¼" F/D (77k); C int; 12", 24 x 80 VDU; RS232 port; P/P.	TDOS; *Basic; Cobol; Fortran; Pascal.*	TDOS is CP/M compatible. Opt: single 5¼" F/D (77k) £250 (up to four); dual 8" F/D (2Mb) £1800. (S&H)
Tandy TRS80 Level 1 (£335)	Tandy: 021 556 6101 (200)	4-16k RAM; Z80; C; 12", 16x64 VDU.	Basic (4k ROM); A.	Expandable to Level II. Many extras available. (I).
Tandy TRS80 Level II (£408)	As above	4-48k RAM; Z80; C; 12", 16x 64 VDU; RS232 port; 1 P/P.	Basic (4k ROM); *M/A; Fortran.*	16k machine includes N/P. 4-16k upgrade £87, 48k system £620; Option: single 5¼" F/D (78k) £295, (subsequent £277, up to 4. BT 6/80 (I).
Tandy TRS80 Model 2 (£1999)	As above	32-64k RAM; Z80A; single 8" F/D (500k); 12", 24x80 VDU; 2 S/P; 1 P/P; N/P.	DOS; Basic.	64k version £2249. Expandable to four F/D drives, single drive expansion £799: three drive £1589.
TECS (£1200)	Technalogics Computing Ltd: 061-793 5293 B&B Computers Ltd 0204 26644 (TBA)	4-56k RAM; 8k PROM; 6800/6809; 2xC; TV int; 2xRS232 ports; internal viewdata modem & printer port.	FLEX; Basic; *Pascal; TDOS; A; T/E; Pilot; Fortran; Cobol.*	Fully viewdata compatible. Options — dual 5¼" F/D (320k) £850; dual 8" F/D £120 £1200. (S&H).
Terodec DPS 64/1 (£3099)	Terodec (Micosystems) Ltd: 0734 664343 (8)	64k RAM; Z80; dual 8" F/D (1Mb); 12", 24x80 VDU; 2 S/P: 3 P/P. Options: dual 8" F/D (1Mb) £1150; with 2Mb £1455.	CP/M; *Basic; Cobol; CBasic; Fortran; Algol; Pascal.*	TMZ 80 enhanced model in integral workstation £5595 (with 4Mb F/D). DPS 64/2 with 2Mb F/D £3404. (S&H).
TI 99/4 (£750)	TI: 0234 67466 (TBA)	16k RAM; 26k ROM; 9900; 24x32 VDU; 2x C int; TV int; RS232 port.	OS; Basic.	Can run 16-colour TV screen. BT 5/80 (S).
Triton L8.2 (£611)	Transam: 01-405 5240 (N/A)	32k RAM; 8080; C int; 16x64 VDU int; 1 S/P; 1 P/P.	4k monitor; Pascal (20k ROM); *CP/M; Pascal.*	Graphics; 5¼" or 8" F/D are available; L7.2 with 2k monitor and Basic (no Pascal) £409. (S&H).

List of Abbreviations

A	Assembler	F/D	Floppy disk	M/A	Macro assembler	S/P	Serial port
BT	Bench Tested	G/C	Graphics card	N/A	Not available	T/E	Text editor
C	Cassette	H	Hardware	N/P	Numeric pad	TBA	To be announced
E	Extensive	H/D	Hard disk	O/S	Operating system	U	Utility
		I	Introductory	P/P	Parallel port		
		Int	Interface	S	Software		

Please note: Software items listed in *italic* are not included in the basic price of the equipment. All prices are *exclusive* of VAT.

IN STORE

DIRECT ACCESS

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
UDS 3000 (£2300)	Kemitron: 0244 2187. (TBA)	64k RAM; Z80A; dual 8" F/D (500k); 2 x RS232 ports. Opt: with dual 8" F/D (2Mb) £2500.	CP/M; *Basic; Cobol; Fortran; Pascal.*	Full range of industrial support cards. Multi-user with H/D avail. soon. (E)
Vector MZ (£2595)	Almarc: 0602 62503 (3)	56k RAM; Z80A; dual 5¼" F/D (630k); 3 S/P; 2 P/P.	CP/M; Basic; *Algol; Cobol; Pascal; Fortran; Coral; CBasic;* A.	High resolution graphics. Also system B with video board & terminal £3195. (E).
Vector System 2800 (£4195)	As above	56k RAM; Z80A; dual 8" F/D (2.4Mb); 3 S/P; 2 P/P.	As above.	High-res graphics. Also System 3030 with 32Mb H/D and single 5¼" F/D £7500. (E)
Video Genie EG3003 (£330)	Lowe Electronics: 0629 2817 (N/A)	16k RAM; Z80; 500bps C; 32x64 TV int; extra C int; 1 P/P.	Basic (12k ROM); *M/A; Fortran.*	Graphics available.
WH8 (£352)	Heath 0452 29451 (N/A).	16-64k RAM; 8080A (or Z80); 4 S/P. Option: single 5¼" F/D (102k) £241.	OS; HDOS; CP/M; *Fortran; Pascal; Basic*	Kit. 3 drives max. Colour graphics avail. (S&H) BT 2/80.
Zentec (£4838)	Zygal Dynamics: 02405 75681 (TBA)	32-64k RAM; 2x8080; dual 5¼" F/D (256k); 15", 25x80 VDU; RS232 port.	O/S; A; U; *Basic;* Cis Cobol.	User programmable character se set. Option: dual 8" F/D (1Mb). (S).
Zenith WH-11A (£2673)	Heath Ltd: 0452 29451 & 01-636 7349 (N/A)	LSI 11; 16-32k RAM; 25x80 VDU; S/P; P/P.	*O/S; Basic; Fortran;* A; U.	PDP 11-compat. Option: 2x8" F/D (1Mb). £1717 (S&H).
Zenith Z89 £1570-£1710	As above	16-48k RAM; Z80; single 5¼" F/D (102k); 12" 25x80 b&g VDU; RS232.	*Basic; A; HDOS;* CP/M; *MBasic; CBasic: Fortran.*	3 x 5¼" F/D possible. Options: dual 8" F/D (1Mb) £1717, 20Mb H/D.
Zilog MCZ 1/05 (portable); MCZ 1/20A (£3250)	Micropower: 0256 54121. Memec: 084421 5471 (N/A)	64k RAM; Z80; dual 8" F/D (600k); RS232 port; MCZ 1/20A only 1 P/P; Option: 10Mb H/D £7100	RIO; O/S; *Cobol; Basic; Fortran; Pascal; M/A; U.*	Available desk top or rack mounted. Debug in 3k PROM. 1/20A runs multi user Cobol, up to 5 terminals with 40Mb H/D.(S&H).
Z-Plus (£3950)	Rostronics Ltd: 01-874 1171 (16).	64k RAM; Z80; dual 8" F/D (1Mb); 4 S/P; 2 P/P.	CP/M; A; U; *Basic; Cobol; Fortran; Pascal; APL; PL/1; Algol.*	Available with 2Mb F/D. Option: 20Mb H/D £4000. BT 12/79 (S&H).

SINGLE BOARDS

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software/ Firmware	Miscellaneous (Documentation)
Acorn System 1 (£65)	Acorn: 0223 312772 (10)	1/8k RAM; 6502; EPROM socket; Hex K/B; C int; 8-digit LED display; up to 16 ports. Options: Eurocard 64-way connector; VDU card; full K/B card.	½k monitor; *Basic.*	Kit. Programmable address linking. On-board 5 V requlator. Available assembled £79. Can be expanded to disk-based system. (S&H).
Aim 65C (£285)	Pelco: 0273 722155 (7)	1-4k RAM; 6502; 4-20k ROM; Full K/B; 2xC; 20 char LED; 20 char thermal printer; RS232 port.	A. Dis A; T/E; 8k monitor; *Basic (8k ROM); PL65.*	Power supplies and two types of case avail. Can be expanded to disk system. (E).
Biproc (£119)	B L Micros: 0494 443073. (TBA)	1k RAM; Z80; TV int; RS232 port. Opt: 4k RAM £8; K/B £30.	2k Monitor; A.	With 9980 instead of Z80 £155, as well as Z80 £180. Kit. (H)
Cromemco SC (£260)	Comart: 0480 215005 (17)	1k RAM; Z80A; 8k EPROM sockets; RS232 port; 3 P/P. Option: S100 bus.	Monitor; *Basic.*	5 program interval timers. Can put own Basic programs in EPROM.(E).
Elf II (£60)	Newtronics: 01-348 3325 (N/A)	¼-64k RAM; RCA 1802; Hex K/B; 2-digit LED; TV int; C int; RS232. Options: Full K/B; VDU card.	1k monitor; A; Dis A; T/E; Elf-bug; *Tiny Basic; Basic.*	TTY, N-line decoders. Low resolution graphics (high res avail). Kits or built. (H).
Explorer (£82)	As above	4-64k RAM; 8085; Hex K/B; RS232 port; S100 bus; C int; 1k video RAM.	2k monitor; *Basic; CP/M.*	Supplied in kit or built. Full range of peripherals including F/D. (H).
Hewart 6800S (£299)	Hewart: 0625 22030 (N/A)	16k RAM; 6800; full K/B; VDU int; 2xC int; 1 S/P; 2 P/P; Option: 16k RAM £90.	1k monitor; A; T/E.	Can be upgraded with 6809. (H).
Hewart 6800 Mk III (£152)	As above	1k RAM; 6800; VDU board.	1k monitor.	Options: single 5¼" F/D (75k) £350; PROM programmer £32. (H).
Microtan 65 (£69)	Tangerine: 0353 3633 (6)	1k RAM; 6502; 16x32 TV int; Options: 64x64 Pixel graphics £6.50; 16k RAM £56.	1k monitor; *Basic.*	TANEX expansion kit with 7k RAM; 4k EPROM sockets; 10k Basic; 4 S/P; 32 P/P £145. (E).
Nascom 1 (£125)	Nascom: 02405 75155 (20)	4k RAM; Z80; Full K/B; TV int; 2 P/P; 1 S/P. Options: 16k RAM £140; single 5¼" F/D (250k) £240 (4 disk controller £127).	2k monitor; *BBasic; Tiny Basic; A; T/E; U.*	Kit. Built verstion £140. Also Nascom 2 with 8k Microsoft Basic in ROM £225 (no RAM). (S&H).
77/68 (£90)	Newbear: 0635 30505 (N/A)	4k RAM; 6800; LED; C int; VDU int.	1k monitor; *Basic.*	Expandable to 64k RAM with F/D. (B).
79/09 (£65)	As above	1k RAM; 6809; P/P; S/P.	2k Monitor.	Designed to upgrade 77/68. (H).
SBC 100 (£135)	Airamco: 0294 57755 (TBA)	1k RAM; Z80; 8k ROM; S100; 1 S/P; 1 P/P.	*1k monitor; DOS in ROM.*	Kit. Available assembled £196. (E).
Superboard (£188)	(as Challenger)	4-8k RAM; 6502; 10k ROM; full K/B; VDU int; C int.	Basic (8k ROM).	Options: RS232 port; single 5¼" F/D (100k) £316; 8k RAM £188. (S&H).

List of Abbreviations

A Assembler
BT Bench Tested
C Cassette
E Extensive
F/D Floppy disk
G/C Graphics card
H Hardware
H/D Hard disk
I Introductory
Int Interface
M/A Macro assembler
N/A Not available
N/P Numeric pad
O/S Operating system
P/P Parallel port
S Software
S/P Serial port
T/E Text editor
TBA To be announced
U Utility

Please note: Software items listed in *italic* are not included in the basic price of the equipment. All prices are *exclusive* of VAT.

DIRECT ACCESS

SINGLE BOARDS

Smoke Signal SCB 68 (£174)	Systems Implementation Ltd: 06924 5666 (TBA)	1k RAM; 6800/6809; 10-20k EPROM; 1 S/P.	2k monitor.	Many expansion boards available including F/D. (H)
SYM-1 (£160)	Newbear: 0635 30505 (N/A)	1-4k RAM; 6502; C int; VDU int; 2x6522 ports. Option: TV int.	4k monitor; *Basic; A.*	Expandable to 64k RAM with F/D. (B).
Triton L5.2 (£294)	Transam: 01-405 5240 (N/A).	1-3k RAM; 8080; 1k VDU RAM full K/B; 16x64 VDU *or* TV int; C int; 1 S/P.	1½k monitor; 2½k Basic.	64-char graphics. Disk int running CP/M about £200. (S&H).
Tuscan (£195)	As above	8k RAM; 8k ROM; Z80A; 5xS100 slots; RS232 port; TV int; C int; 1 P/P.	*2k monitor; 8k Basic; CP/M; Pascal.*	High res. graphics available. Can be expanded to F/D system. (S&H).
UK101 (£179)	Comp Shop: 01-441 2922 (4)	4k RAM; 6502; full K/B; 16x48 VDU or TV int; C int; RS232 port, Options: 4k RAM £29.	1k monitor; 8k Basic; *Dis A; U.*	Graphics. Will run Superboard software. New monitor EPROM with enhanced U £22. (S&H).
ZCB (£260)	Almarc: 0602 625035 (3)	1k RAM; Z80A; 3 PROM sockets; RS232 port; 3 P/P.	*Will take any 2708/ 16/32 software.*	S100 bus compatible. Expandable to full system. (E).

TRANSACTION FILE

The classified service that's free to non-commercial readers. Advertisements (50 words max) to: PCW Transaction File, 14 Rathbone Place, London W1P 1DE.

For sale

North Star . . . Horizon-based system, quad density, 48k, printer VDU, CAP-CPP business s/ware (all ledgers & wage packages), unused, complete system £4,500 ono. Mr Kendrew, 461 Ongar Rd, Brentwood, Essex. Tel Coxtie Green 72386.

UK101 . . . 8k RAM, new monitor, 1 or 2 MHz switchable, RS232, data bus buffer, cased, boxed PSU, hour meter & s/ware, £300 or more. Tel Kez, Uxbridge 59309.

ZX80 . . . assembled with adaptor adaptor, all leads, Linsac ZX80 Companion, all s/ware, £80. Tel Mans (0623) 58553.

Video display card . . . (Thompson -CSF), cover to u/l case, + key board (George Risk), UHF mod, PSU. Just plug into TV for complete VDU with RS232 int. £85. Tel 01-790 0066 day, 01-431 0729 eve.

FullASCII. . . keyboard, brand new, common built in case with cable, connector & circuit diag, £65 ono. Tel 01-449 9035 (Barnet)

ZX80 . . . complete with leads, PSU & manual, virtually unused due to purchase of MZ-80K, £80 ono. Tel Dave Playfair, Rayleigh 743087.

PET 2001 . . . 8k, new ROM, central London, £370. Tel 01-834 8269 (eves), 01-213 4194 (day).

ZX80 . . . 3k RAM pack, £30 ono. Tel 0480 66038 eves.

TRS-80 L2 . . . 16k, green screen monitor, numeric keypad, £360 ono. Tandy Quick-Printer, £60 ono. Tel Worcester (0905) 51477.

UK101 . . . 8k RAM, cased, custom-built PSU, fully working, £230. Tel Mr Stobbs, Walsall 32511 day, 403353 eves.

ZX80 . . . Sinc built, PSU, leads, manual, as new, £70. Tel Ruislip 38204.

8k Basic . . . ROM for Nascom, £15. Tel Largs (0475) 674329.

Apple II . . . 16k, new and unused, manuals & maker's warranty, still in box, offers around £700. Tel Witcombe 3968.

Sharp PC1201 . . . prog cale, 128 steps, fully merged (same as fx501p), inc instr manual, app/ prog manual, recharger with rechargeable alls, 3 months new, £35. Tel 01-591 1478.

ZX80 . . . Sinc built, inc adaptor & leads, etc, £90 ono, or swap for Nascom 1, PSU & doc, cahs adjustment if nec. Tel Luton 595713.

MK14 . . . Issue 5, RAM/IO, extra opt RAM, SOC revised monitor, cass int, PSU, Manual, SC/MP Programming (Kimitron), extra doc, £45. VDU, £25. Tel 0642 316096 after 6.

HP41C . . . new, unwanted, DD390 Teletype, paper tape punch/reader, also Kim 1 with tape, PSU. Offers or swaps, tel Ware 870507, eves.

PET 8k . . . small keyboard, fitted Toolkit, Superchip, perspex green screen, soundbox, lots of s/ware, £350 ono. Tel 01-866 3326.

UK101 . . . 8k RAM, 8k ROM, cased, with all leads, ready to go, £270. Also Compshop's new monitor (ROM chip), £20, and some s/ware — will fit EPROM if req. Tel 01-363 5961 after 6.

Ohio Superboard II . . . only 4 months old, cased with 3 amp PSU, 3k RAM, little used, some games & s/ware tapes, £200 ono. Tel Clive Goodsell, Richmansworth 75617 after 7.

ZX80 . . . Sinc tested, new cond, all leads, PSU, manual & extra progs on cassette. The wife says it goes or she does! £67.50 inc postage. Tel Graham, Par 4515, Cornwall.

HP41C . . . with additional mem module, all standard manuals, case etc, £170 ono. Tel Peter Jost, 01-493 1235 ext 3767, office hours.

Olivetti TE300 . . . printer terminal, 110 baud, RS232 serial int, paper tape punch, tape reader (latter needs attention), stand, cables, some paper, manual, £225 ono. Tel Watford 34560 eves.

TI59/PC110C . . . as new, with blank mag cards, printer paper, full doc, all in perfect cond, offers around £210. Tel 01-736 3596 eves.

MZ-80K . . . 48k RAM, only 3 weeks old, inc 2 Basics on tape, manual, over 60 progs, hardly used, full warranty, £520 ono. Tel Bruce, 01-995 4965 after 5.

PET . . . high density graphics board/extra 8k memory. Complete MTU set-up, inc PET interface, card file, s/ware. Best offer over £150. Tel Canterbuty 57995 after 6.

PET 32k . . . dust cover, 2 cass decks, Toolkit, £700. Tel Rayleigh, Essex, 774718.

48k Apple II+ . . . 6 months old, disk drive with controller, integer card, 9" b/w monitor, Visicalc, 50+ games, case, £1350 (save £40 £400). Tel 092681 4282.

TI59C . . . brand new, with manuals & master module inc progs, retains progs indefinitely, buyer collects. Cost £90, accept £74. Tel Whitchurch (Hants) 2602 eves.

TI58 . . . prog calc with mains adaptor, manuals etc, good cond, £35. Tel 0482 861496.

TRS-80 L2 . . . monitor, exp int, 1 floppy disk drive, printer int, RS232 board, Newdos+, TRSdos 2.2, editor/assembler, cass rec, lots of s/ware, all manuals, soundbox, offers. 01-866 3326.

S100 memory boards . . . 2-off 8k Econoram II, working, as new, £60 each, £110 pair. Tel Camberley (0276) 61543 after 6.

Superboard . . . 8k RAM, PSU, modulator, case (not fitted), offers around £215. Tel Southend-on-Sea 204901 after 7.30.

MK14 . . . new monitor, max onboard RAM, RAM I/O chip, add-on no bounce keyboard, experimental I/O board & PSU, all manuals, book on SC/MP programming, £70 ono. Tel Derby (0332) 701964 after 6.

TRS-80 L2 16k . . . with modulator for TV, in as new cond, boxed, hardly used, £325. Tel A Bhatti, 01-574 5038 after 7.

TI59 . . . prog calc, print cradle, full doc, mag prog cards, programmer utilities listings, rechargeable batteries, listing function, graphics, s/ware check on h/ware, security lock, hardly used, £300. Apply: S Gillgrass, Dept of Psychology, Eleanor Rathbone Building, University of Liverpool, Liverpool.

Teletype 33 ASR . . . very good cond, recent overhaul, RS232 int, £350 ono. Tel Aldershot 314937.

Nas-sys 1 . . . monitor for Nascom 1/2, £10 or why? Tel Hitchen (o462) 56733.

ASR33 . . . Teletype with paper punch, good cond, £230 ono. Tel Steve Fitzgerald, 0865 52728.

Research Machines . . . 380Z, 48k, 80-col, 60 1pm X-data printer, 2 8" floppies, 2 cassettes, dual cassette controller, keyboard, VDU, extensive CP/M s/ware, exc cond, selling for financial reasons — offers. Tel Alyth (08283) 2787.

Horizon . . . computer, exc cond, complete with VDU, £1000. Tel C Baker, 0332 72569, eves.

PET 8k . . . £370. PET cassette m/c with built-in soundbox, £40. Tel High Wycombe 33164.

ZX80 . . . 1 month old, ass & full fully working, leads & Sinclair Basic manual, £80 inc UK postage postage. Tel Marlow 2389 eves.

PET 8k 2001 . . . old ROM, green screen, many progs (Microchess, Backgammon, Wartrek, Lem Lander), £360 ono. Also TI59 prog calc with manual, uses rechargable batteries, £110 ono. Tel 01-407 4521 day, 02-01-398 0930 eves.

Centronics 701 . . . tractor printer with leads & lots of ribbons, £450. Tel Mr Ellis, 01-399 0207 (office), 01-549 3233 (home).

PET 32k . . . new ROM, green screen, Programmer's Toolkit & Superchip ROMs fitted (cost over £100) which add many new featu features & commands, also cass deck & some games/business s/ware, £650. Tel 0303 862967 (home).

PET2001-8k . . . small keyboard, plus usual s/ware, sound box, etc, £379; Epsom TX80 printer, as new, complete with IEEE-488 int & cable, £365. Tel Kevin, 01-360 9576 (Enfield), eves.

ASR33 . . . printer with manuals, paper & tape, recently overhauled, £250 or will haggle/exchange for computer equipment — why? Tel Reg Broadberry, Bristol 56621 eves.

UK 101 . . . new monitor in ROM with orig instruction sheet, £16; assembler/editor, unused with manual, £10. Unneeded because I'm using disks. Write: J Rudge, Brendon Cottage, Riverside Drive, Esher, Surrey, tel Esher 66453.

PET 8k . . . old keyboard, with programmers toolkit, serial & parallel ints, soundbox, all manuals, progs like chess, assembler, star wars, othello, etc (total 40), 2nd cass drive, £500. Tel Ashtead (03722) 77570 w/ends only please.

Exchange . . . 1 Superboard II (8k) + s/ware & PSU + £180 for a PET (8k) + s/ware. Tel 061-225 4093 after 6.

Printer . . . Data Dynamics KSR 390, ASCII code, RS232, 110 baud, with keyboard, switch selectable simplex/duplex, 80-col, with stand, £135. Mr S Moss, 44 Premier Ave, Grays, Essex.

UK101 . . . just 3 months old, prof built, 4k RAM, PSU, 8k Microsoft Basic, new 2k monitor in 2716 EPROM allowing screen editing, flashing cursor, data saving on tape, etc, in large Microtype series 3 case, room for exp boards, fan etc, comes with full doc, sacrifice at £225. Tel 08444 4537.

Cash crisis . . . forces sale of 3 month old TMZ-80 micro comp with VDU, 4 8" floppy disks, built into work desk, 4 Mbytes total disk capacity, 64k RAM, with CP/M 1.4 & CP/M 2.2, MBasic interpreter, Cobol, Pascal, Fortran, £5,500. Tel 0793 31404.

ZX80 . . . assembled, brand new, unwanted gift, cost £100, accept £80. Tel 01-593 4235.

Centronics . . . 101A printer, 165 cps, 7x9 dot matrix, paper width to 15 3/8", with strong Centronics table, £630 ono. David Fox, 17 Mornington Ave, Wokingham, Berks, tel (0734) 734343.

Video Genie . . . 16k, little used, guaranteed, with some tapes, superb first computer, save over £100, yours for £300. Tel Collins, 0788 77177.

TRANSACTION FILE

Nascom 2 . . . 16k DRAM board, PSU & full doc, ass & running @ 4 MHz, TV & cass rec inc, games tape, £350. Tel 051-339 4821.

ZX80 . . . 1 month old, all leads, PSU, cass rec, manuals, some progs, ideal for beginner, £80 ono. Tel Cliff, 01-515 4595 (eves) or 01-980 9124 (day).

Casio FX502P . . . with FA1 cass int, prog library, instructions & original packing, good cond, owner gone micro, £85 ono or anyone willing to sway for N2 memory? Tel Camberley (0276) 63726 eves.

Two black and white . . . TVs (would make good monitors), dual trace scope, 200 electronics & computing journals, must sell, accept any offer around £100. Tel Ingrebourne 75432 after 5.

Superboard II . . . case, PSU, 4k, modulator, 50 Hz, as new, offers around £180. Write: D Jackson, Room M2-2 Darwin College, The University, Canterbury, Kent CT2 7NY.

Is there anyone . . . out there who's like to buy my Casio FX502P plus FA1, cass int, music adaptor & leads, manuals, prog library, demo cass & some original progs, for only £85 ono. Tel 0572 3643 w/ends.

Sorcerer 48k . . . 4 months old, seldom used, 8 months warranty to go, £505 ono, inc TV modulator. Tel 01-205 3521.

TI57 . . . prog calc, complete with games, financial, conversion, phone call monitoring software, rechargeable batteries, mains unit, carrying case & intro to programming manual, £20. Tel 022 023 3718.

Compukit UK101 . . . 8k RAM, cased with software & doc, only £240. Mr M Lancaster, 4 Hanover Place, London Rd, Bath, Avon.

TRS-80 L2 16k . . . complete with Trendcom printer, trolley stand, games, business progs, spare tapes, £495, or sell printer separately. Tel 051-526 7087.

HP29C . . . 9 months old; HP9835A, 64 kbyte memory, 15 months old; HP9866B thermal printer for parts — heads & 2 logic boards down; HP 16-biy I/O interface. Reasonable offers to 05805 2674.

CBM Assembler . . . package/chip £40; PET Revealed £5; CBM Soundbox, £10; floppies, inc games, 20 for £35; PET programming manual, £3; mags & newsletters. The lot for £80. Tel Jeremy, 01-954 6464, eves or w/ends.

Acorn System 1 . . . assembled with PSU & manuals, good cond, £65 ono Tel Guildford 75809.

ZX80 . . . factory built & in perfect order, comp with PSU & leads, £80. Tel South Benfleet 52147.

Sixteen. . . 4027 memory chips, 8k, suitable Nascom, etc, £10. Phone Dave, 0702 218662.

Nascom 2 . . . 16k dyn RAM board, built & tested in prof aluminium cabinet with integ cass, fan, PSU & graphics ROM, £450 ono. Tel Scarborough (0723) 73178.

PET extras . . . Programmer's Toolkit (for old ROMs), PET workbooks 1-6 & The Pet Revealed, various games & blank tapes, £50 the lot. Tel Guiseley (0943) 78047 eves or w/ends.

Brand new . . . 8k PET, large Keyboard, new ROMs, in maker's box fitted with 'Mu-metal' screen eliminating screen wobble, £420, buyer collects. Tel Whitchurch (Hants) 2602 after 6 day weekdays, anytime w/ends.

Chalco . . . PTR CCT, £50; D43R scope handbook, £60; SA400 drive, little used, £150. Will haggle. Tel 047485 3585, w/ends.

Nascom 1 . . . 32k, Vero frame, buffer, motherboard. W Stuart colour board, 3 amp PSU, power filter, Nas-sys, T4, Basic 10 books books, 10 programs £240. Tel Fareham 280829, 9-5.

DEC PDP-8/L. . . minicomputer, 4k core, ASR teletype with paper tape punch/reader, Teletype interface, software — Basic, Fortran, PAL III Assembler, Focal, binary and rim loaders, symbolic editor; the lot for £300. Phone Byfleet 44531.

Acorn Atom. . . fully assembled with all leads, 2k RAM, PSU 'Atomic' Manual, £120 ono. Mr L R Jackson, 97 Bracebridge Street, Nuneaton CV11 5PB.

TRS-80 Level I 4k. . . with cassette, VDU and manuals, needed for a sixth form pupil at school. Tel Brownhills 4104 (Walsall, West Midlands).

TEC: full editing VDU, RS232 interface, etc. offers over £100. Also 1 other 'normal' VDU, lots of spares and manuals, offers over £50. Tel: Pete 01-998 7604.

PET 2001 8k. . . small keyboard, plus sound box, books, mags, cassette prog's on learning Basic and Invaders, Microchess plus ma many more; worth £150, all for £390 Tel: Terry, 01-534 1114.

TRS-80 Level 2. . . 16k, video monitor etc, as bought from Tandy, inc £200 of software and Aculab floppy tape drive, software inc edtasm +; total cost: £959, nearest offer to £600 secures. Tel: 01-445 3281 (N. London).

Nascom. . . Veroframe, £20; Nascom 2 keyboard enclosure, £3; Nascom motherboard + 5 Nasbus edge connectors, £15; 8 x MK4118 static RAM, £70 or £10 each. Tel: Bedford (0234) 852942.

Expandoram II. . . S100 16k dynamic ram board, expands to 64k, £199. Contact: Mike Barbury, 17 Landeryon Gardens, Penzance, Cornwall (0736) 798157 after 7.

ZX80. . . including all leads and adaptor, ZX80 companion, 4 new cassettes for recording progs, £80. Tape with games on £4. Tel: Amersham 6635.

Why wait. . . 8 weeks for your ZX80. You can have my brand new, Sinclair-built ZX80 now for £90 (unwanted gift). Tel: 09323 44531.

HP-41C. . . and 2 memory module modules, complete with documen documentation and programs, sold as new, £150. Contact Fareham (0329) 280642 or 6 Blaven Walk, Fareham, Hants, after 6pm any evening.

PET Hi-Res. . . One only Micro Technology Unlimited K-1007-1 interface board, unused, converts any PET expansion port for use with MTU's externally-mounted K-1008P high-res graphics and other functions. Complete with instruction book: £30. F Chambers, Rock House, Ballycroy, Westport, Co. Mayo, Ireland.

Casio FX502P. . . plus FA1 cassette interface, brand new, still boxed, unwanted Christmas present, only £65 for both, Tel: 01-703 0424 after four weekdays.

6809. . . single board S100 processor with 1k RAM, 2k ROM with space for 10k 2400 baud guaranteed cassette interface, I/O, keyboard port, RS232 level shifters, with full documentation, £150. Tel: Aaron James, 01-959 4851.

Sorcerer 32k. . . Basic, word processing rompacs: Paper Tiger, graphics option: new LOBO 1.2Mb dual 8" Shugart drives, double density, single sided, case with fan, power supply: new JADE S100 disk controller, Z80A, Western FD179-01, CP/M 2.21: TUM 10" monitor: will split, offers. Tel: 01-584 5000 ex 3081 day, 01-680 2284 evenings, ask for D J Bishop.

Tuscan. . . S100 computer, w/o disk drives, 8k RAM Basic/2k ROM monitor, on-board VDU, 771 keyboard, 5 months old, all manuals, £500 ono. Tel: Rob, 01-267 6447 after 6.

Low cost. . . 16k system, Nascom 1 with Nassys, 3A PSU, hi-speed CUTS, Smart 1 32k RAM/buffer board with 16k installed, system needs repair, will split, best offer accepted. Write to 17 Greenwood Drive, Sheffield S9 4GY.

PET 16k. . . new rom, large keyboard, cassette and software including assembler, PET documentation, Commadore programming & hardware manuals and 6502 assembly language book, and PET revealed, £500 Tel: Yeovil 20596

ZX80. . . with PSU, perfect working order, Sinclair assembled, manual, leads, plus cassette carrying 15 games, £70. Tel: (Wellingborough) (0933) 224526. Gautrey, 1 Wilbye Grange, Wellingborough, Northants, NN83PS

Centronics 101...printer 165 cps, 132 col, manual, £450. SWTP CT64 terminal, matching monitor (also UHF modulator), manual, £300. Marconi Elliott Videodata 4000 Terminal — Ex/Rx ASCII or Baudot, offers? ASCII keyboard with 12 key control cluster, fine steel case, £30. May view working; deliver 50 miles Luton. Tel: 0525 220261.

UK101. . . 8k RAM, cased, assembler, disassembler, switchable 300/600 baud cassette interface, new monitor ROM, transformer inside case, heaps of software inc. 'Invaders', 'Programming the 6502', recorder thrown in, £300. Tel: Colin, 01-703 9742 eves.

Computhink. . . 800k disk drive, 2 months old, cost at current prices £1316, will sell for £800. Tel: Felix, 01-979 1328 eves or w/ends.

Superboard. . . 8k RAM, PSU, modulator and case (not fitted), offers around £215. Telephone Southend-on-Sea 204901 after 7.30.

Acorn System One. . . professionally assembled and tested, 6502 micro, with cassette interface, perfect condition, with full documentation, £75. Tel: Deal 62517 (eves).

TRS-80. . . Quick Printer II, 32 chars./line or double width. Users inexpensive aluminium paper, two rolls and cable included, as new £100. Tel: Rickmansworth 76021 (eves only).

Wanted

Cheap printer . . . + int for Apple II (or just Apple compat printer). Tel Duncan, Canterbury 57995 after 6.

Exchange . . . my 1972 Triumph GTIII, 1 yrs MOT, zero rust, good all-round cond, value £1200, for micro set-up. Will swap or cash adjust either way but regret no kits. Tel John, Southend 40295 office hours only.

ZX80 . . . either 1k or 16k, pref with 8k Basic ROM. Must be built & running with cass leads etc. Any stats packages also bought — good price paid. S. Gillgrass, c/o Dept of Psychology, Eleanor Rathbone Buildings, University of Liverpool, Liverpool.

CBM PET . . . or similar, any cond as long as it works (only limited funds available). Will collect within reasonable distance of Bournemouth. Tel John Woods, 0202 524060.

NETWORK NEWS

This month we introduce a new 'Direct Access' section. Personal computer networks have been springing up all over the States for 18 months or more and now we have two in Britain. As more networks appear — and as more facilities are added to existing networks — we'll report them in this section, which will appear monthly from now on.

Forum-80. . . operated by Frederick Brown, tel: Hull (0482) 859169. No access charge, open to any micro owner. Operating Tues & Thurs 1900-2200, Sat & Sun 1200-2200. Facilities: bulletin board, program library for downloading (all in Microsoft Basic).

National TRS-80 Users' Group. . . being set up at time of writing, will be available to all micro users, not just TRS-80 owners. Initially access charge will be a £10 sub, but as more join, this will be reduced and refunds made accordingly. Facilities: bulletin board & programs for downloading. Contact: Brian Pain, tel 0908 566660 (office).

USER GROUPS INDEX

As promised, here is a complete printout of our User Group Index. If we have failed to indicate YOUR group, then please address the relevant information to PCW (User Group Index), 14 Rathbone Place, London W1P 1DE. Notification of changes will also be appreciated. The next full listing will appear in PCW's May edition. In the meantime we shall of course continue to publish User Group Index update information — as and when it reaches us.

INTERNATIONAL

Tangerine Users Group (International). Recently formed for users of the Microtan 65, the TUG will act as a central information clearing house, including exchange of programs etc. Annual membership is £5.00. Details from TUG at 3/22 Donoughmore Road, Boscombe, Bournemouth, Dorset, UK.

USCD System User Society. Set up in San Diego in June for users of USCD Pascal, the society aims to establish a software library, promote regional and special interest group activities and liase with USCD system distributer Softech on future development plans. Existing special interest groups include industrial application, word processing, real time, business applications and forward planning. UK contact: John Ash, Dicoll Data Systems Ltd., Bond Close, Kingsland Estate, Basingstoke, Hants RG24 0QB.

Microcomputer Users Club: recently established for program writing and exchange, emphasis on 6502/Z80 users. Contact c/o Synthetronics Microcomputers P.O. Box 151, 1322 Hoevik, Norway.

Group/380. Recently established for information interchange on microsystems equivalent to IBM 360/370 main frames. Group expects to see several desktop 370 systems available in next few years; services offered include newsletter on hardware & systems developments and read/write postal access to a computerised database listing relevant software from the large volume of existing 360/370 software which will eventually be of use to users of micro 360/370-equivalent systems. Annual sub: $10 for individuals, $25 for organisations. Contact: Mokurai Cherlin, PO Box 1131, Mount Shasta, CA96067, USA.

NATIONAL

Amateur Computer Club. National organisation with several local groups which hold their own meetings and talks. *Accumulator* newsletter issued bi-monthly; software libraries for 6800, Z80 & 6502 processors available. Contact: Jim MacDonald, 1 Carlton Court, Studley Grange Rd, London W7 2LU.

11s Users Group. A sort of help service only. No meetings no newsletter. Contact: Pete Harris, 119 Carpenter Way, Potters Bar, Herts, EN6 5QB. Tel: 0707 52091 or 01-248 8000 Ext. 7065.

The 6502 Users Club. Hoping soon to hold regional and national meetings, they offer "support, encouragement and fellowship". Contact: Walter Wallenborn, 21 Argyll Ave., Luton, Beds LU3 1EG.

77/68 Users Group. Quarterly Newsletter. Free membership for 1st year if you buy the 77/68 instruction manual, £1.50 thereafter. Contact: Newbury Computing Store, 40 Bartholomew St., Newbury, Berkshire.

9900 Users Group TIMUG. Contact: Chris Cadogan, 21 Thistle Downs, Northway Farm, Tewkesbury, Glos.

Amateur Computer Club — 2650 Library. No meetings, no newsletters, the library serves to act as a help point for disseminating 2650 related data on demand. Contact: Roger A. Munt, 51 Beechwood Drive, Feniscowles, Blackburn, Lancs BB2 5AT (0254 22341).

Minicomputer Users in Secondary Education (MUSE). MUSE is the national organisation for coordinating activity in schools, teacher training institutions, colleges of technology and so on. Meetings are held on both a regional and national basis. For full details on MUSE's range of activities, contact the Treasurer, R. Trigger, 48 Chadcote Way, Catshill, Bromsgrove, Worcestershire.

UK Intel MDS Users Group. Contact: Lewis Hard, 29 Chaucer Rd., Bedford.

Ithaca Audio S100 bus UK User Group. Contact: Dave Weater, 16 Etive Place, Cumbernauld, Glasgow 067 4JE. Phone 02867 36570.

MK14 Club. Bi-monthly magazine called "Complement and Add". Contact: Geoff Phillips, 8 Podsford Rd., London NW9 6HP.

Independent PET users Group. Contact: IPUG, 57 Clough Hall Road, Kidsgrove, Stoke-on-Trent, Staffs.

Research Machines Ltd. National User Group. Contact: M.D. Fischer, PO Box 75, Oxford, OX4 1EY, for a registration form.

UK Apple Users Group. Contact: (Keen Computers) 5 The Poultry, Nottingham. Tel: 0602 583254/5/6.

Central Program Exchange. Full membership (£25 Europe, £40 overseas) provides 30 free programs p.a. Small User Service (£10 Europe, £20 overseas) provides 10 free programs p.a. Contact: Mrs Judith Brown, The Polytechnic, Wilfruma St., Wolverhampton, WV1 1LY.

Cosmac Users Coub (proposed) For people using the RCA 1802, Cosmac ELF, ELFII, Super ELF etc. Those interested contact James Cunningham at 7 Harrowden Court, Harrowden Road, Luton LU2 0SR (enclosed sae, please).

National TRS-80 Users' Group. Activities include a computerised bulletin board service (see 'Network News'). Contact: Brian Pain, National TRS-80 UG, 40A High St, Stony Stratford, Milton Keynes, tel (0908) 566660 (office), 564271 (home).

ZX80 Users Club. The group's aim is to create and share software which will fit within the machine's 1K RAM. Membership is free and first move will be to distribute a newsletter. Address to write is: 44-46 Earls Court Road, London W8 6EJ.

Ohio Scientific UK User Group. Independent of OSI, an important role will be the disentangling of poor documentation. There will be regular newsletters and membership is at present £5 per year. The group will initially be concerned with the practical aspects and applications of OSI systems — rather than with games. Contact Tom Graves at: 19a West End, Somerset, BA16 0LQ.

Medical Micro Users Group. Set up to enable medical micro users to locate programs already written in their field by other medics. Newsletters and meeting in the pipeline — contact P.J.V. Dixon, c/o MEDICOM, 1-2 Hanover Street, London W1.

UK Pet Users Club. Contact: Commodore Systems Division, 360 Euston Road, London NW1 3BL.

British TI Users' Club. A loose association of owners and users of Texas Instruments programmable calcs, the club exists for the purposes of information and program exchange (and is in no way sponsored by TI). The main activity is production of a (roughly) monthly newsletter and membership costs £5.50. Details from 2 Woodside Crescent, Clayton, Newcastle-under-Lyme, Staffs ST5 4BW.

ZX80 Users Club. Bi-monthly newsletter. Low cost software. Technical support. Subscription £6 (UK), £10 (overseas). Contact: D. Blagden, PO Box 159, Kingston upon Thames, Surrey, KT2 5UQ. (s.a.e. for further information).

COMP 80 Users Group. Monthly newsletter. Annual subscription £5. Contact: Philip L. Probetts, 50, Cromwell Road, Wimbledon, London, SW19 8LZ.

National Personal Computer Users Association. Full membership now costs £8.00, but you'll receive a free datasheet of special routines for the UK101/Superboard on enrolment (routines include a fast Basic line renumberer only four lines long). For detail details send an SAE to: The Secretary, NPCUA, 11 Spratling Street, Manston, Ramsgate, Kent.

Powertran Users Club. Annual subscription £5.00, which includes a monthly newsletter. Contact Mr P L Probetts, 50 Cromwell Road, Wimbledon, London SW19 8LZ.

Acorn Atom User Group. Set up for interchange of software & hardware tips. Membership costs £4 pa inc. access to program library & free newsletter. Group supported by but independent of Acorn Computers. Contact: T G Meredith, "Sheerwater", Yealm View Rd, Newton Ferrers, S. Devon.

National T158/59 Club: bi-monthly newsletter, program exchange etc. Annual sub £5.50 or, if you include a program with your cheque then it's £3.50. Contact: R M Murphy, Dept. of Electronic Engineering, University College Swansea, S. Wales.

Sharp User Group: Sub £3. p.a., inc newsletter and free Space Invaders cassette for MZ-80K. Contact: Knights TV & Computers, 108 Rosemount Place, Aberdeen. Tel 0224 630526.

Sorcerer Program Exchange Club; Contact Colin Morle, 32 Watchyard Lane, Formby, Nr. Liverpool L37 3JU, Tel 070 48 72137.

TRS-80 Level 1 User Group. For all Level 1 users. Qtrly newsletter containing s/ware (also avail. on cassette). £3 p/a for newsletter, or £7 p/a for news & cassette. Contact (with SAE): N Rushton, 123 Roughwood Drive, Northwood, Kirkby, Merseyside L33 9UG.

CP/M Users' Group (UK). Annual sub £5. S/ware library, newsletter, 'help' service. Contact: 11 Sun St, Finsbury Sq, London EC2M 22D.

British Apple Systems User Group Group. For Apple II and ITT 2020 users. Meets 1st Tues eve & 3rd Sun afternoons monthly at The Old School, Branch Rd, Park St, St Albans (on A5 about 2 miles south of city centre). Contact: John Sharp, Garston (09273) 75093 or David Bolton, Park Street (0727) 72917.

Anyone interested in forming a Texas T199/4 Users' Club with a magazine and a software library, should contact Mr P Dicks, Data Processing Manager, Pershke Price Service Organisation Ltd, Dover House, 141 Morden Rd, Mitcham. Surrey CR4 4XB, tel. 01-648 709 7090.

Sharp PC-1211 Users' Club. Also open to TRS-80 Pocket Computer owners and anyone else with or without a computer. Membership costs £5 p/a which includes a newsletter containing programs etc. Contact: Jonathan Dakeyne, 281 Lidgett Lane, Leeds LS17 6PD.

SOUTH

Southern Users of PETs Association. Free membership, meet first Wed. each month. £1.50 for monthly newsletter. Contact: 42 Compton Road, Brighton BN1 5AN.

NORTHWEST

Manchester Computer Club (formerly the Amateur Computer Club (Northwest Group)). Meets 1st & 3rd Thursdays monthly at St Peter's Chaplaincy, Precinct Centre, Oxford Rd, Manchester. Contact: David Wade, 28 Hazel Rd, Altrincham, Cheshire WA14 1JL, tel: 061-941 2486.

TRS 80 — North West Group. Subscription £5. Newsletter £3 (for 6 issues). Meetings last Wednesday monthly (not Dec) at the Stag Hotel, Carswood, Nr. Wigan. Contact: Melvyn D. Franklin, 40 Cowlees, Westhoughton, Bolton, BL5 3EG. Tel: 0942 812843.

Northwest Computer Club. Fortnightly meetings. 25p attendance fee. No subscriptions. Contact: John Lightfoot, 135, Ashton Drive, Frodsham, Warrington, Cheshire, WA6 7PU. Tel: 0928-31519.

IRELAND

Computer Education Society of Ireland. A voluntary organisation that consists of a national body and an expanding number of local branches. Their brief is to monitor computer education in Ireland. *National CESI* (£3 p.a.) — Dairmuid McCarthy, 7 St. Kevin's Park, Kilmacud, Blackrock, Co. Dublin. *Cork branch* (£1 extra) — Michael Moynihan, Colaiste an Spioraid Naomh, Bishopstown, Cork. *Dublin branch* (£1.50 extra) — Jim Walsh, C.B.S. Naas, Co. Kildare. *Limerick branch* (£1 extra) — Sr. Lourda Keane, Convent F.C.J., Laurel Hill, Limerick. *Waterford branch* (£1 extra) — Mr. Hugh Dobbs, Newtown School, Waterford. *Kilkenny branch* (£1 extra) Sr. Helen Lenehan, Presentation Secondary School, Kilkenny.

WALES

Gwent Amateur Computer Club. Covering the Gwent and Cardiff areas, the club has its own computer room and technical library. Meetings are held once a week on Wednesdays at 10 Park Place, Newport. Contact Ian Hazell on 0633 277711 (office hours).

SCOTLAND

The Grampian Amateur Computer Society. They meet every 2nd Monday of the month at the Holiday Inn, Bucksburn, Aberdeen and there's a monthly newsletter. For more details, contact M. Basil, Orton Cottage, Burnside, Lumphanan, Kincardineshire, Grampian Region (033 983 784).

USER GROUPS INDEX

Central Scotland Computer Club. Meets first and third Thursdays each month at Falkirk College of Technology, Grangemouth Rd, Falkirk. Contact J Lyon, 78 Slamannan Rd, Falkirk FK1 5NF, tel. 22430.

Crampian Amateur Computer Society. Meets second Monday monthly at local hotel, looking for own premises. Sub £4 p/a (£1 for junior members), monthly. About 50 members. Club owns an ICL 1902! Contact: Alan Hird, 20 Harcourt Rd, Aberdeen, Grampian, tel (0224) 33102.

AVON

Bristol Computing Club, £3.00 p.a. Meetings 3rd Wednesday, monthly. Contact: Leo Wallis, 6 Kilbirnie Rd., Bridge Farm Estate, Bristol, BS14 0HY. Tel: Bristol 832453.

Brunel Technical College Computing Club. The club divides into two sections. . . the "skilled" and the "not skilled". They share alternate Wednesdays at the College. Contact: S.W. Rabona at 18 Castle Road, Worle, Weston-Super-Mare, Avon, BS22 9JW (0934 513068).

Compukit User Club. Details, contact P. Crabb Esq., 21 Jones Close, Yatton, Avon (0934 834808).

BERKSHIRE

The Thames Valley Amateur Computer Club. Meetings are on the first Thursday of every month and from November on, that will be at "The Southcote", Southcote Lane, off the Bath Road, Reading, Berks. Starting time, 7.00pm. Contact: Brian Quarm (Camberley 22186) OR Brian Steer (Slough 20034).

BUCKS

Would anyone interested in setting up an Apple Users Group in the Bucks/Berks area contact: Steve Proffitt, Tel: 01-759 5511 ext 7298 (day), or Marlow 73074 eves or w/ends.

CAMBRIDGESHIRE

Peterborough Computer Club. Recently formed, eets on first and third Mondays each month at Adult Education Centre, Brook Street, Peterborough. Contact: T Marchant, tel Peterborough 76681 after 6 weekdays, anytime weekends.

CLEVELAND

Cleveland Micro Computer Users Group. Adult Meetings 3rd Tuesday monthly, under 18s — 2nd Tuesday. Yearly subscription £2 ((18), £3 (18-21), £5 (21+). Journal. Contact: J. Telford, 13, Weston Crescent, Norton, Cleveland.

CORNWALL

Cornish Computing Club. Recently formed by members of the Cornish Amateur Club. Meets 7.30pm 3rd Monday monthly at the SWEB Social Club, Pool, on A30 between Redruth & Camborne. Contact: Richard Frost, Trecarne, Alexandra Rd, Illogan, Redruth TR16 4EA.

Anyone interested in forming a computer club in Cornwall, catering mainly for PET, ZX80 and UK 101 computers should contact: M F Grove, 35 Causeway Head, Penzance, Cornwall.

DEVONSHIRE

Exeter and District Amateur Computer Club. General meetings 2nd Tuesday monthly, specialist meetings 3rd or 4th Tuesday. £5.00 p.a. Contact: Doug Bates, 3 Station Road, Pinhoe, Exeter, Devon.

Plymouth and District Amateur Computing Club. Subscription £5.00 p.a. Meetings last Wednesday monthly. Contact: Keith Gould, c/o JAD Ltd., 21 Market Ave., Plymouth 62616 or 2 Brook Rd., Ivybridge 2399.

DORSET

Bournemouth Area Computer Club. Meets monthly at the Kinson Community Centre. Contact: Peter Hills, 54 Runnymeade Ave, Bournemouth, Dorset BH11 9SE, tel Northbourne 6547.

COUNTY DURHAM

Computer Club. Business & Word Processor section meets Fridays 7.30, Scientific & Recreational Saturdays 10.00. Contact: L. Boxell, 8 Vane Terrace, Darlington. Tel: 0325 67766.

Northeast PETS. Contact: Jim Cocallis, 20 Worcester Road, Newton Hall Estate, Durham. They meet the 2nd Monday of each month for software tuition and the 3rd Monday for hardware tuition (both in addition to normal activities). They start at 7.00pm and meet in the PET Lab, Newcastle Polytechnic, Ellison Building, Newcastle upon Tyne.

EAST ANGLIA

Anglia Computer User Group. Contact Jan Rejzl, 128 Templemere, Sprowston Road, Norwich NR3 4EQ.

EAST MIDLANDS

East Midlands TRS-80 Users' Group. For owners/would-be owners of TRS-80s or Video Genies. For free newsletter and further details contact: Mike Costello, 17 Langbank Avenue, Rise Park, Nottingham NG5 5BU.

ESSEX

TRS80 User Club (Chelmsford). Now part of the National TRS80 User Club. Contact: Michael Dean, 22 Roughtons, Galleywood, Chelmsford, Essex.

The Colchester Microprocessor Group. Meetings held at the University of Essex on the second and fourth Wednesdays of each month — 7.30 pm start. Membership is open to all, on payments of £5 annual sub (£1 for full-time students). Contact: the Information Centre at the University on the evening of the meeting.

Compukit User Club. Details, contact Adrian Waters, 117 Haynes Road, Hornchurch, Essex RM11 2HX (Hornchurch 40490).

Springfield Computer Club. Special interest in Sorcerer but beginners and others welcome. Meetings 1st Friday monthly. Contact: Stephen Cousins, 1, Aldeburgh Way, Springfield, Chelmsford, Essex CM1 5PB. Tel: 0245 50155.

South East Essex Computer Society. Meets monthly at the Southend-on-Sea College of Technology, has access to the college's micros, and is open to anyone over 14. Contact: R Knight, 128 Lt. Wakering Road, Lt. Wakering, Southend-on-Sea, Essex. Tel: Southend 218456.

GLOUCESTERSHIRE

Cheltenham Amateur Computer Club. Meetings, 4th Wednesday monthly, 7.30pm start. Contact: Mr. M. Pullin, 45 Merestones Drive, The Park, Cheltenham, GL50 2SU (Cheltenham 25617).

HAMPSHIRE

Southampton Amateur Computer Club. Meets 8 pm 2nd Wed each month (not July — Sept) at Medical Science Building, Bassett Cres. East, Southampton. £3 pa, OAP, & students £2. Newsletter & special int. groups; 2 yrs old, 80 members soon setting up another club in Portsmouth area. Contact: P G Dorey, Dept Physiology, The University, Southampton SO9 3TU or Andy Low, Tel: (0703) 555 605 ext 34.

HERTFORDSHIRE

Harpenden Microprocessor Group. They hold meetings every fortnight, cover a wide range of interests and attract members from the area around Luton, St. Albans and Welwyn. Contact: David James, 5 Ox Lane, Harpenden, Herts AL5 4HH (05827 5366).

ISLE OF WIGHT

IoW TRS-80 Users Club: Meets each Friday at 8 pm at 72 Union Street, Ryde. Contact: Mr M R Collins, 3 Altofts Gardens, Ventnor, IoW.

KENT

MACRO (Medway Amateur Computer & Robotics Organisation). Meets monthly, sub £3. Contact: Mrs Christine Webster, 13 Ladywood Road, Cuxton, Rochester, Kent Tel: 0634 78517

North Kent Amateur Computer Club. Meetings, the second Tuesday of each month — usually at the Charles Darwin School, Jail Lane, Biggin Hill, Kent. The sub is £2.50 per annum (£1 for students). More members are needed. . . contact: Barry Biddles at 3 Acer Road, Biggin Hill, Kent (09594 71742).

LANCASHIRE

PET Users' in West Lancs. Meets monthly on third Thursday each month at Arnold School Blackpool. Contact: David Jowett, 197 Victoria Road East, Thornton, Blackpool FY5 3ST. tel Cleverleys 869108.

Merseyside Microcomputer Group. Several sub-groups including: 380Z User's Group (Alan Pope on 051-924 2470); Computer Education Society (Mr M. Trotter on 051-652 1596); SC/MP Special Interest Group (Bob Perrigo on 051-677 6716); PET Special Interest Group; 6800 and 77/68 Special Interest Group; Apple Special Interest Group. The Secretary is John Stout of the Dept. of Architecture, Liverpool Polytechnic, 53 Victoria Street, Liverpool L1 6EY (051-236 0598).

North Lancs User Group. Contact John Robinson, 12 Harold Ave., Blackpool, Lancashire.

Chorley Computer Club. PET-biased but owners of other (or no no) computers welcome. Meets informally on alternate Tuesdays in a pub in Chorley. Contact: Rod Wilson, tel Chorley 71875 or Chris Hicks, tel Chorley 78376.

LEICESTERSHIRE

The Leicestershire Personal Computer Club. Meetings held the 2nd Monday in each month, at Leicester University and Loughborough University alternately. They start 7pm. Membership is £2 per annum (£1 for under 16s). Contact: Miss Jill Olorenshaw (Club Secretary) c/o Arden Data Processing, Municipal Buildings, Charles Street, Leicester (0533 22255) OR Mr Dick Foden (Club Chairman) at 11 Gaddesby Lane, Rearsby, Leicester.

LINCOLNSHIRE

Lincolnshire Microprocessor Society. Various meeting places. For up-to-date information, contact the Hon Sec, Mr Eric Booth, Senior Common Room, Bishop Grosseteste College, Newport, Lincoln.

LONDON

TRS-80 Users' Group London Branch, recently formed and meet meets 2nd Friday each month 6pm, at 292 Caledonian Rd, London N1. Contact: J Wellsman, 01-607 0157.

Compucolor User Group, London area. Has contacts with both US and Canadian Compucolor user groups. Contact: Bill Donkin, 19 Harwood Ave, Bromley, Kent BR1 3DX.

380Z User Group, North London Branch. Includes Herts, Cambs, Oxon. Contact: Sheridan Williams, 35 St Julian's Rd, St. Albans, Herts AL1 2AZ.

West London Personal Computer Club. Meets first Tues. each month at Willesden Technical College. Also visits, special int. groups, demos, problem surgeries. Contact: Graham Brain, 81 Rydal Cres, Perivale Middx, Tel: 01-997 8986

Southgate Computer Club. The club recently held its AGM and adopted a formal constitution. Annual subscription will be £2.50 from January 1981, including a club newsletter; full-time students under 18 pay half-cost. The club now has 83 members. Contact: Panos Koumi, Southgate Computer Club, 33 Chandos Avenue, London N14.

East London Amateur Computer Club. Meetings 3rd Tuesday monthly. £2.50 p.a. (½ price to school students). Contact: Dr. Graham Crisp, 45 Leadale Ave, Chingford, London E4 8AX. Tel: 01-520 6010.

The North London Hobby Computer Club General meetings held on a Wednesday evening, once a month — specialised topics on three evenings each week. Location: The Polytechnic of North London. Contact: Robin Bradbeer (Chairman) at the Dept. of Electronic and Communications Engineering, Polytechnic of N. London, Holloway, N7 8DB (01-607 2789).

SELMIC (South East London Microcomputer Club). Meets fortnightly at Thames Polytechnic. Annual sub £5. Contact: Peter Phillips, 61 Craigerne Rd, London SE3, tel 01-853 5829.

Croydon micro/small computer group. Contact Vernon Gifford, 111 Selhurst Road, London SE25 6LH.

East London Amateur Computer Club. Meets 7—10pm on 2nd & 4th Tuesdays monthly at Harrow Green Library, Leytonstone, London E11. Contact: Fred Linge Linger, 01-554 3288.

LONDON & SOUTH EAST

Sharp MZ-80K User Group. Contact: Joe L.P. Seet, 16, Elmhurst Drive, Hornchurch, Essex, RM11 1PE. Tel: 04024 42905.

Sunbury Amateur Computer Club Club. Meets 1st Friday monthly whenever possible, 20p per meeting. Contact: S Taylor, 8 Priory Close, Sunbury-on-Thames TW16 5AB, tel Sunbury 86649.

MIDDLESEX

Sunbury Amateur Computer Club. Membership free. Contact Mr S N Taylor, 8 Priory Close, Sunbury on Thames, Middlesex. TW16 5AB. Tel: Sunbury 86649.

Harrow Computing Group. Meetings on alternate Wednesdays at 7pm in room G43 of Harrow College of Higher Education. They welcome anyone with an interest in computers — with or without a machine. Membership is free. For further information contact Bazyle Butcher, 16 St. Peter's Close, Bushey Heath, Herts WD2 3LG (01-950 7068).

USER GROUPS INDEX

IPUG setting up in Teddington. Interested? Contact: G. Squibb, 108, Teddington Park Road, Teddington, Middlesex.

MIDLANDS

Birmingham Computer Club. To be formed shortly, catering for all micro users. Fortnightly meetings planned but venue not yet fixex. Contact: Dr M Bayliss, 021-743 7197.

TRS-80 Independent User Group. Recently formed in Birmingham. Contact Mike Bayliss, 021-743 7197.

NORTHANTS

Anybody interested in forming a microcomputer users club in the Towcester (S. Northants) area, please contact R J Wellsted, 20 Hampton Court Close, Abbey Chase, Towcester, Tel: Towcester 51354 eves.

NOTTINGHAMSHIRE

Ashfield Computer Club. Meets 1st & 3rd Thurs each month at Carsic Junior School, membership £3 pa. Contact Deric Ellerby. tel 0380 75376 or Derrick Daines tel 0380 56198

OXFORDSHIRE

Oxfordshire Microcomputer Club. £5.00 p.a. Contact: S. C. Bird, 139 The Moors, Kidlington, Oxford OX5 2AF Tel: Kidlington (08675) 6703.

Microsoc the Oxford University micro group holds shared meetings with the Oxford Microcomputer Club. Contact: M. Bourla, St. John's College, Oxford.

SOUTH

IPUG South East Regional Group. Meets third Thursday each month, 7.30pm at Charles Darwin School, Jail Lane, Biggin Bill. Bi-monthly newsletter. Contact: W Cdr M Ryan, 164 Chesterfield Drive, Sevenoaks, Kent TN13 2EH, tel (0732) 53530.

SUFFOLK

Anyone interested in forming a Suffolk Computer Users' Club should contact Ian on Ipswich 831353 eves/weekends.

SURREY

Richmond Computer Club. Held the second Monday of each month at the Richmond Community Centre (20p per meeting), members have the use of a good range of equipment. Contact: Robert Forster, 18a The Barons, St. Margarets, Twickenham, Middx (01-892 1873).

Surrey Microprocessor Society. (SUMPS) Covering Surrey plus bits of South London and other adjacent counties. Anyone interested in joining, call Mike on 01-642 8362.

SUSSEX

A PET group is being formed on the Sussex/Surrey border, presently centered on Crawley & Horsham. Aims to meet monthly & produce a monthly newsletter. Contact: Richard Dyer, 33 Parham Rd, Ilfield, Crawley RH11 0ET.

A Crawley computer club has recently been formed, open to anyone interested in personal computing, with or without computing facilities. The intention is to hold meetings weekly, and publish a monthly or bi-monthly newsletter. Details, contact either Mr J. Fieldhouse, 18 Seaford Road, Broadfield, Crawley, West Sussex (Crawley 542509) — or — Mr J. M. Clarke, 31 Hyde Heath Court, Pound Hill, Crawley, West Sussex (Crawley 884207)

TYNE AND WEAR

Newcastle-upon-Tyne Personal Computer Society: meets first Tues each month in Room D103, Newcastle Polytechnic. Over 60 members sub £5.00. Several sub-groups inc. PET, TRS-80 and S100 (last one meets weekly). Contact Pete 0632 573905 or John on 0632 579887.

WARWICKSHIRE

ACC (Midland) Group. They meet every 3rd Saturday in room P109 at Lanchester College, Coventry . . . no sub, no magazine. Contact: Roy Diamond (Chairman), 27 Loweswater Road, Coventry, Warks (0203 454061).

WEST MIDLANDS

Research Machines 380Z. West Midlands User Group. Further details from: Peter Smith, Birmingham Educational Computing Centre, Camp Hill Teachers Centre, Stratford Road, Birmingham, B11 1AR. Tel: 021 772 6534.

West Midlands Amateur Computer Club. Meets the 2nd & 4th Tuesday of each month, usually at Elmfield School, Love Lane, Stourbridge, West Midlands. Annual sub is £3 (£2 if full time student). . . visitors welcomed without obligation. For more information contact John Tracey of 100 Booth Close, Kingswinford, West Mids (0384 70097).

Compukit User Club. Details, contact S.H. Grisvenor Esq., 11 Bernard Road, Oldbury, Warley, West Midlands (021-422 3298).

YORKSHIRE

Anyone interested in forming a micro group in the Doncaster area, contact Mr P Flinders, tel Doncaster 78954 or Doncaster 868 379, 6—9pm.

Shipley College Computer Group (Sorcerer/6800). They meet Tuesdays (software) and Wednesdays (hardware/advanced) between 7.00 & 9.00 pm. Contact Paul Channell on Shipley 595731.

West Yorkshire Microcomputer Group. Formed following an inaugural meeting on October 23rd, a varied diary of events has been drawn up. For details contact the Chairman, Phillip Clark, Care Computer Services, 15 Wellington Street, Leeds LS1 4DL (0532 450667) OR the Secretary, Keith Knaggs, Price Waterhouse & Co., Leeds (0532 448741).

South Yorkshire Personal Computing Group. Meetings are on the second Wednesday of each month in Room F135, St. Georges Building, Sheffield University. Experts and beginners welcomed alike, contact Paul Sanderson (Secretary), 8 Vernon Road, Totley, Sheffield S17 3QE (0742) 351895.

Penine & District Computer Club. Open at both 26 and 51 Mill Hey, Haworth, W. Yorks. each Sat & Sun 10am to 10pm. Systems, books, magazines, members' shop. Contact: club at w/ends on Haworth 43007 or chairman, Douglas Bryant, on Bradford 569660.

DIARY DATA

Bahrain	Middle East Electronic Comms. Show & Conf — MECOM. Contact: Arabian Exbn. Management, 49-50 Calthorpe Rd., Edgbaston, Birmingham. 021-454 4416	2 — 5 Feb
Eindhoven, Holland	Int. Microelectronics Sub. Systems Trade Fair — Microelectronica. Contact: Golden Gate Exbns Inc, PO Box 428, Los Altos, CA94022, USA	4 — 6 Feb
Bilbao, Spain	Electrical & Electronic Equip Exbn — ELA Contact ECL Ltd, 01-486 1951.	2 — 8 Mar
London, England	(Wembley Conf C) Microsystems '81 Exbn. Contact: IPC Exbns Ltd, 01-837 3636	11 — 13 Mar
Glasgow, Scotland	(Albany Hotel) Computermarket. Contact: Couchmead Ltd., 42 Gt Windmill Street, London W1. 01-437 4187	17 — 19 Mar
Malmo, Sweden	Computer Exbn — DATAKRAFT. Contact: ECL Ltd, 01-486 1951	23 — 27 Mar
Manchester, England	(New Cent. Hotel) Computermarket. Contact: Couchmead Ltd., 01-437 4187	24 — 26 Mar
Dublin, Eire	Int Computing Exbn — COMPUTEX. Contact: SDL Exbns Ltd, Dublin 763871	24-27 Mar
London, England	(Wembley Conf Centre) Numerical Control Equip Exbn & Conf. Contact: British Numerical Control Socy, 01-579 9411	30 Mar — 1 Apr
Birmingham, England	(Albany Hotel) Computermarket. Contact: Couchmead Ltd, 01-437 4187	31 Mar — 2 Apr
London, England	(West Centre Hotel) Peripherals '81 Exbn. Contact: IPC Exbns Ltd, 01-837 3636	1 — 3 Apr
London, England	(West Centre Hotel) Computermarket. Contact: Couchmead Ltd, 01-437 4187	7 — 9 Apr
Paris, France	Int Exbn of Electronic Components. Contact: French Trade Centre, 01-439 3964	7 — 11 Apr
Kenilworth, England	(Nat. Agric. Centre) Computer Numerical Control Equip, Machine & Services Exbn & Conf. Contact: Corinthian Exbns, 01-681 7055	12 — 14 Apr
London, England	(Grosvenor House) All Electronics Show. Contact: All Electronics Show, (0799) 22612	22 — 24 Apr

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Sub Set is not confined to Z80 routines; by sheer coincidence the original contributors were Z80 users, but contributions, documented as shown here, are most welcome from users of other processors. Send your subroutines to:
PCW Sub Set, *PCW*, 14 Rathbone Place, London W1P 1DE

We are often told that any code that works is good code and here is your chance to judge the truth of this.

In the November issue, we asked for the shortest solution to HL = HL/2, when HL contains four BCD digits. There is a lot to be learned from the different ways you found of doing this. All of them work and leave any remainder in the carry flag.

Here is the longest solution, which does the job in 81 bytes and 331 — 361 T states:

```
HLFW:  PUSH  BC        ;save
       PUSH  DE        ;registers.
       LD    A,£0F     ;get
       AND   H         ;all
       LD    C,A       ;four
       SRL   H         ;BCD
       SRL   H         ;digits
       SRL   H         ;from
       SRL   H         ;HL
       LD    B,H       ;into
       LD    A,£0F     ;registers
       AND   L         ;B
       LD    E,A       ;
       SRL   L         ;C
       SRL   L         ;
       SRL   L         ;D
       SRL   L         ;and
       LD    D,L       ;E.
       SRL   B         ;divide B by 2
       JR    NC,HLF1   ;and if
       LD    A,+10     ;there is
       ADD   A,C       ;carry add
       LD    C,A       ;10 to C.
HLF1:  SRL   C         ;divide C by 2
       JR    NC,HLF2   ;and if
       LD    A,+10     ;there is
       ADD   A,D       ;carry add
       LD    D,A       ;10 to D.
HLF2:  SRL   D         ;divide D by 2
       JR    NC,HLF3   ;and if
       LD    A,+10     ;there is
       ADD   A,E       ;carry add
       LD    E,A       ;10 to E.
HLF3:  SRL   E         ;divide E by 2.
       PUSH  AF        ;save any carry.
       SLA   B         ;move digit
       SLA   B         ;in B to
       SLA   B         ;most signfc
       SLA   B         ;end and
       LD    A,B       ;load into A.
       ADD   A,C       ;add digit from C
       LD    H,A       ;& store in H.
       SLA   D         ;move digit
       SLA   D         ;in D to
       SLA   D         ;most signfc
       SLA   D         ;end and
       LD    A,D       ;load into A.
       ADD   A,E       ;add digit from E
       LD    L,A       ;& store in L.
       POP   AF        ;
       POP   DE        ;
       POP   BC        ;
       RET             ;
```

Its method is crystal clear and the easiest of all to follow.

From A H Yates of Hemsworth comes this code, which does the same job in 34 bytes and introduces two different ways of adjusting for a carry from a previous digit:

```
HLFX:  PUSH  BC        ;save registers.
       LD    B,+0      ;zeroise B.
       BIT   0,H       ;if will be cy
       JR    Z,HLF4    ;from 2nd digit
       LD    B,50H     ;set B = 50H.
HLF4:  SRL   H         ;divide H by 2.
       BIT   3,H       ;if carry
       JR    Z,HLF5    ;from 1st digit
       LD    A,H       ;subtract
       SUB   3         ;3 from
       LD    H,A       ;second digit.
HLF5:  SRL   L         ;divide L by 2.
       PUSH  AF        ;save flags
       BIT   3,L       ;if carry
       LD    A,L       ;from 3rd digit
       JR    Z,HLF6    ;subtract 3
       SUB   3         ;from 4th digit.
HLF6:  ADD   A,B       ;make any adjust
       LD    L,A       ;to 3rd digit.
       POP   AF        ;
       POP   BC        ;
       RET             ;
```

Neil Imrie, from Bedford, sent a routine which, with two bytes added to make it strictly comparable to the other routines by returning the remainder in the carry flag, takes 29 bytes and 123—129 T states. Neil introduces yet another way of adjusting for a carry into the third digit:

```
HLFY:  LD    A,H       ;1st 2 digits/2.
       SRL   A         ;2nd 2 digits/2.
       RR    L         ;with cy from A.
       PUSH  AF        ;save flags.
       BIT   3,A       ;if carry from
       JR    Z,HLF7    ;1st digit take
       SUB   3         ;3 from 2nd.
HLF7:  LD    H,A       ;store first
       LD    A,L       ;part result.
       BIT   7,A       ;if carry from
       JR    Z,HLF8    ;2nd digit take
       SUB   30H       ;3 from 3rd.
HLF8:  BIT   3,A       ;if carry from
       JR    Z,HLF9    ;3rd digit take
       SUB   3         ;3 from 4th.
HLF9:  LD    L,A       ;store result.
       POP   AF        ;
       RET             ;
```

Computer clubs

Neil is a member of the newly-formed Bedford Computer Club. It might be of interest to readers if other contributors will name any computer club which they belong to. It will show which clubs have members active in machine code programming and ready to share their efforts freely. I am a member of the Southgate Computer Club.

Jan Beckman of Ashstead sent a routine in 29 bytes and 119—130 T states to match Neil's and starting:

```
HLFZ:  ZOR   A          ;clear A & cy.
       RR    H          ;H/2. L/2 with
       RR    L          ;cy from H.
       PUSH  AF         ;save flags.
       BIT   3,H        ;if carry
       JR    Z,HLF7     ;from 1st
       DEC   H          ;digit
       DEC   H          ;reduce 2nd
       DEC   H          ;by 3.
       LD    A,L
                        ;continue as
                         in HLFY
```

The Ultimate

By juggling with parts from these different routines, you might well come up with something better than any of them. But before you rush to send it in, take a look at our first Datasheet this month, HLFHL, which, by an entirely different method, does the job in 21 bytes. This was sent by Dave Barrow who, like Mr Yates of HLFX, comes from Hemsworth.

Dave also sent the same three improvements to RLTV that we received from Paul Jenner and printed last month and Paul Bloomfield of Bryanston School got two of them.

I hate to disappoint any speed merchants by pointing out that HLFHL takes 960-978 T states to execute. It seems you can't have everything but we did ask for the shortest, not the fastest, solution.

I set out to shoot down the notion that any code that works is good code but perhaps, for some purpose, it is, when speed, brevity and clarity do not go together.

Datasheet

```
;= HLFHL — BCD digits in HL / 2.
;/ CLASS: 1
;/ TIME CRITICAL ?: No
;/ DESCRIPTION: Divides by 2 four BCD digits in HL, setting the
;/                carry if there is a remainder
;/ ACTION: Reset carry flag initially
;/          [If carry then: high nibble H ⟵ high nibble H — 6.]
;/          [Rotate HL left through carry so that:           ]
;/          [bits 3210,L ⟵ carry and bits 765,H              ]  4 times.
;/ SUBr DEPENDENCE: None
;/ INTERFACES: None
;/ INPUT: HL contains four BCD digits
;/ OUTPUT: HL contains the four BCD digit result of the division
;/          by 2.
;/          Carry is set if HL was originally an odd number.
;/ REGs USED: A, HL and Flags
;/ STACK USE: 2
;/ LENGTH: 21
;/ TIME STATES: 960-978
;/ PROCESSOR: Z80
HLFHL: PUSH  BC       ;save BC              C5
       LD    B,A0H    ;2's complement of 60H 06 A0
       LD    A,+4     ;digit counter        3E 04
       OR    A        ;clear carry          B7
LOOP1: JR    NC,JUMP  ;skip if no adust to make 30 01
       ADD   HL,BC    ;make into decimal carry 09
JUMP:  LD    C,+4     ;bit counter          0E 04
LOOP2: ADC   HL,HL    ;rotate HL left through ED 6A
       DEC   C        ;carry to bring next digit 0D
       JR    NZ,LOOP2 ;into high nibble H   20 FB
       DEC   A        ;repeat until         3D
       JR    NZ,LOOP1 ;finished             20 F3
       POP   BC       ;restore BC           C1
       RET            ;return               C9
```

Some of you intentionally wandered from the point to offer routines of more general application. Roger Hargrave from Crawley sent this routine to divide by two the BCD digits in A and set the carry if there is a remainder:

```
HLFA   PUSH  DE       ;
       RR    A        ;rotate right.
       PUSH  AF       ;save carry.
       BIT   3,A      ;if carry from
       JR    Z,HL11   ;1st digit take
       SUB   3        ;3 from 2nd.
HL11   BIT   7,A      ;if previous
       JR    Z,HL12   ;carry take
       SUB   30H      ;3 from 1st.
HL12   POP   DE       ;recover carry
       LD    D,A      ;and marry
       PUSH  DE       ;it to new
       POP   AF       ;result in A.
       POP   DE       ;
       RET            ;
```

HL can then be divided by two, thus:

```
XOR   A        ;clear carry.
LD    A,H
CALL  HLFA
LD    H,A
LD    A,L
CALL  HLFA
LD    L,A
```

The advantage of this approach is that HLFA can be used to process any string of BCD bytes that can be loaded into A from any pointer (HL, DE, BC, IX+d, IY+d or NN).

Both Jim Chance of Birmingham and Jan Beckman of Ashstead (and HLFZ) sent the same code for our second Datasheet, HLFB, to divide a string of BCD digits at (HL) by two.

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Datasheet

```
;= HLFB — BCD in (HL) / 2
;/ CLASS: 1
;/ TIME CRITICAL ? No
;/ DESCRIPTION: Divides by 2 a string of BCD digits at (HL)
                setting the carry if there is a remainder
;/ ACTION: Get digit to A, add 10 if carry from last digit,
           shift right. Rotate digits back to memory, repeat
           for 2xC digits.
;/ SUBr DEPENDENCE: None
;/ INTERFACES: None
;/ INPUT: C bytes of BCD in (HL) which points to the most
          significant byte
;/ OUTPUT: Input bytes divided by 2. HL points to the lowest
;/         byte. BC=0=A.
;/ REGs USED: AF, BC and HL.
;/ STACK USE: None
;/ LENGTH: 19
;/ PROCESSOR: Z80
HLFB:  X0R   A       ; clear A and carry      AF
BV1:   LD    B,+2    ; 2 digits per byte      06 02
BV2:   RLD           ; get most signif digit  ED 6F
       JR    NC,BV3  ; 10 carried ?           30 02
       ADD   A,+10                            C6 0A
BV3:   RRA                                    1F
       DJNZ  BV2     ; loop for 2nd digit     10 F7
       RLD           ; answer to memory       ED 6F
       DEC   C       ; byte counter           0D
       RET   Z       ; finished ?             C8
       INC   HL      ; get next byte          23
       JR    BV1     ; process it             18 EE
```

Putting it together

If you have a memory-mapped display and have kept all the Datasheets printed in this series, try the code below.

```
LINE1  EQU   aaaa          ;£090A on Nascom
LINE2  EQU   bbbb          ;£098A on Nascom
LINE3  EQU   cccc          ;£0A0A on Nascom
;      Clear the screen
       LD    B,+40         ;enter up to 40
       LD    C,''R         ;ASCII chrs
       LD    DE,LINE1+39   ;calculator
       CALL  LSCN          ;fashion.
       LD    DE,LINE1+39   ;convert
       LD    HL,LINE2+39   ;into BCD
       LD    B,+40         ;on another
       CALL  SNBF          ;line.
       CALL  DL1S          ;delay 1 sec
       CALL  DL1S          ;twice
       INC   HL            ;divide
       LD    C,+20         ;BCD
       CALL  HLFB          ;by 2.
       LD    DE,LINE3      ;convert
       LD    HL,LINE+20    ;divided
       LD    B,+20         ;BCD back
       CALL  BFSR          ;to ASCII.
Return to your monitor.
```

Remember that LSCN needs RLTV and your own routine to get a character from the keyboard into A. This is perhaps not the most useful application that has been devised but it does show that we are getting to the point of putting programs together from the routines that have been printed.

There are now three things you can do in this series:
— understand and improve the routines that are printed;
— contribute your own original routines for others to have a go at;
— exercise your ingenuity in putting routines together.

Cormac Duffin from Northern Ireland but now at Leicester University has sent a shorter version (31 bytes) of BFSL (the left justified version of BFSR we printed in December). Cormac's routine also saves AF and B registers.

Mystery of OP codes

Dave Barrow is intrigued by the missing instruction codes CB 30 to CB 37, which shift left and increment B, C, D, E, H, L, (HL) and A. Since they are not in the CPU's specification, it is assumed that they can not be relied on to work in all circumstances. We would be interested to know whether or not they work on your Z80 machine and, if so, what you can use them for.

Saving registers

Roger Hargrave, when playing with graphics, needs to save and restore all

registers repeatedly and does so by calling:

```
PSHEM:  EX    (SP),HL   ; HL to stack
        PUSH  DE
        PUSH  BC
        PUSH  AF
        PUSH  IX
        PUSH  IY
        PUSH  HL   ; return addr to stack
        RET
```

and

```
POPEM:  POP   HL   ; return addr to HL
        POP   IY
        POP   IX
        POP   AF
        POP   BC
        POP   DE
        EX    (SP),HL
        RET
```

PSHEM carries forward the values of all registers unchanged except for that of HL, which has been used to carry PSHEM's return address to the bottom of the stack. The problem is to carry forward from PSHEM the original values of all registers (including HL) and we want the shortest Class 1 solution.

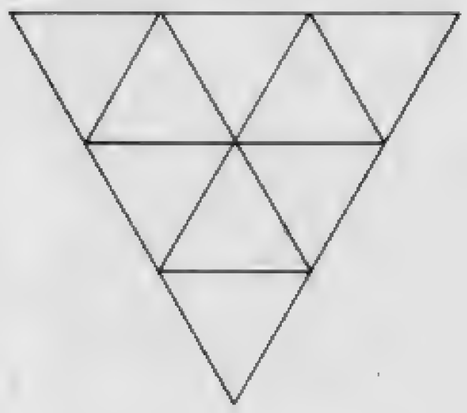
Sub Set is not confined to Z80 routines; by sheer co-incidence the original contributors were Z80 users, but contributions, documented as shown here, are most welcome from users of other processors. Send your subroutines to : PCW Sub Set, *PCW*, 14 Rathbone Place, London W1P 1DE

LEISURE LINES

Well, Puzzle 15 doesn't seem to have been very difficult — only 50 of the 139 answers were incorrect and the randomly-chosen winner is Mrs Julia Todd of New Malden, Surrey. Congratulations, Mrs. Todd — your prize will soon be on its way to you.
The winning solution was:
Max: START-8-14-8-18-14-19-16-18-15-17-FINISH (166)
Min:START-2-2-3-3-7-11-2-2-1-1-8-FINISH (42)
Max difference = 124.

Quickie

As usual, no answers required and no prizes for these.
1. Howmany triangles are there in this figure?



2. One ninth is two less than a third of a half of X; what's X?

Prize puzzle

Messrs Baker, Cooper, Parson and Smith are a baker, a cooper, a parson and a smith. However, no-one has the same name as his vocation. The cooper is not the namesake of Mr Smith's vocation; the baker is neither Mr Parson nor is he the namesake of Mr Baker's vocation. What is Mr Baker's vocation?

Answers on a postcard, please, to Puzzle No 18, PCW, 14 Rathbone Place, London W1P 1DE, to arrive no later than 28 February. The prize is the usual book token.

PROGRAMS

PET Greenfingers by Bob Chappell

Here is a 'vegetable planning' suite of programs.

The first program explains how to use the programs. The second gives sowing, planting and harvesting details for the 20 most common vegetables.

The third program enables you to plan your garden and record the details on tape. It can then be updated with amendments and harvesting details. POKE 59458,30 to restore screen printing to its normal mode.

```
100 REM*"COPYRIGHT*BOB CHAPPELL*28/11/80"*
110 POKE59468,14
120 POKE59458,62
130 L$="▬▬▬
```

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PROGRAMS

```
480 PRINT"■FOR ANY VEGETABLE:-
490 PRINT"■1. THE NUMBER OF ROWS NEEDED.
500 PRINT"■2. THE AMOUNT OF SEED NECESSARY.
510 PRINT"■■FOR TRANSPLANTS,THE PROGRAM WILL LIST:-
520 PRINT"■3. THE TOTAL NUMBER OF PLANTS NEEDED.
530 PRINT"■4. THE SPACING BETWEEN PLANTS.":GOSUB1180
540 PRINT"    ■4. THE MONTHLY CALENDAR.
550 PRINT"■■■FOR ANY MONTH,THE PROGRAM WILL LIST ALL
560 PRINT"■THE SOWINGS AND TRANSPLANTS THAT CAN BE
570 PRINT"■CARRIED OUT IN THAT MONTH,TOGETHER WITH
580 PRINT"■THE LATEST DATES BY WHICH SOWING AND
590 PRINT"■PLANTING SHOULD HAVE BEEN COMPLETED." GOSUB1180
600 PRINT"■  ■GENERAL NOTE.
610 PRINT"■■■FOR ANY LISTING REQUIRED WHERE THE
620 PRINT"■PROGRAM FINDS NOTHING TO REPORT":PRINT"■■E.G. DECEMBER SOWINGS!"
630 PRINT"■THE PROGRAM WILL MERELY PRINT A DOUBLE"
640 PRINT"■LINE,LIKE SO:-":PRINTL$:PRINTL$
650 PRINT"■AND ASK YOU TO PRESS A KEY TO" PRINT"■CONTINUE  -  LIKE NOW!
660 GOSUB1180
670 PRINT"■■PROGRAM "CHR$(34)"VEG PLAN"CHR$(34)" COVERS
680 PRINT"■THE SAME VEGETABLES BUT ALLOWS YOU TO
690 PRINT"■STORE YOUR INDIVIDUAL PLAN ON TAPE." PRINT"■■THE FACILITIES ARE -
700 PRINT"■1. READ IN A PREVIOUSLY RECORDED PLAN" PRINT"    FROM CASSETTE.
710 PRINT"■2. DISPLAY YOUR VEGETABLE PLAN.
720 PRINT"■3. UPDATE THE PLAN." PRINT"■4. RECORD THE LATEST PLAN ON CASSETTE.
730 GOSUB1180:PRINT"      ■1. READ IN A PLAN.
740 PRINT"■YOU ARE PROMPTED TO LOAD THE APPROPRIATE
750 PRINT"TAPE PRIOR TO READING IN A PREVIOUSLY
760 PRINT"■RECORDED PLAN."
770 PRINT"■■OBVIOUSLY, ON YOUR FIRST USE OF THE
780 PRINT"■PROGRAM, YOU WILL NOT HAVE A PREVIOUS
790 PRINT"■TAPE BUT THE PROGRAM ALLOWS YOU TO
800 PRINT"■CREATE ONE FROM SCRATCH."
810 PRINT"■■■ IT IS NOT NECESSARY TO HAVE A RECORDED "
820 PRINT"■PLAN ON TAPE IN ORDER TO USE THE PROGRAM
830 GOSUB1180:PRINT"      ■2. DISPLAY THE PLAN.
840 PRINT"■THE PLAN IS MADE UP OF 100 GARDEN ROWS
850 PRINT"■EACH OF WHICH MAY HOLD INFORMATION ABOUT
860 PRINT"ONE VEGETABLE."
870 PRINT"■FOR EACH 'OCCUPIED' ROW, THE DISPLAY
880 PRINT"■SHOWS -" PRINT"■1. ROW NUMBER." PRINT"■2. LENGTH OF THE ROW.
890 PRINT"■3. NAME OF THE VEGETABLE." PRINT"■4. MONTH SOWN.
900 PRINT"■5. MONTH WHEN PICKING IS EXPECTED." PRINT"■6.THE EXPECTED YIELD.
910 GOSUB1180:PRINT"■■■NORMALLY, THE YIELD IS SHOWN IN LBS.
920 PRINT"■■FOR LETTUCES, AN 'H' INDICATES 'HEADS,' PRINT"■NOT LBS.
930 PRINT"■■FOR PLANTS, A 'T' INDICATES THE YIELD IS
940 PRINT"LBS FROM THE FINAL TRANSPLANTS.":GOSUB1180
950 PRINT"    ■3. UPDATE THE PLAN." PRINT"■THE PROGRAM WILL ASK FOR -
960 PRINT"■1. THE ROW NUMBER (1-100)
970 PRINT"■2. LENGTH OF THE ROW (IN MULTIPLES OF
980 PRINT"■   FIVE FEET, MAXIMUM LENGTH 9995.
990 PRINT"■3. THE VEGETABLE TO OCCUPY THAT ROW.
1000 PRINT"■4. THE MONTH THE SEED WAS SOWN.":GOSUB1180
1010 PRINT"■THE PROGRAM WILL GIVE YOU WARNING" PRINT"■MESSAGES IF  -
1020 PRINT"■1. YOU MAKE AN ENTRY TO A ROW WHICH IS
1030 PRINT"■   ALREADY OCCUPIED." PRINT"■2.  OU ENTER A SOWING DATE THAT IS"
1040 PRINT"■   EARLIER OR LATER THAN THE RECOMMENDED":PRINT"   LIMITS.
1050 GOSUB1180 PRINT"      ■4. RECORD THE PLAN ON CASSETTE.
1060 PRINT"■THE FOURTH OPTION IS 'END OF RUN'.
1070 PRINT"■WHEN YOU SELECT THIS,THE PROGRAM WILL
1080 PRINT"■ASK WHETHER YOU WISH TO WRITE AWAY YOUR
1090 PRINT"■PLAN AND, IF SO, PROMPT YOU TO LOAD A
1100 PRINT"■SPARE TAPE.
1110 PRINT"■THE FINAL THING OPTION 4 DOES IS TO" PRINT"■END THE RUN.
1120 GOSUB1180
1130 POKE59468,12
1140 PRINT"■■■■■THOSE ARE ALL THE INSTRUCTIONS.
1150 PRINT"■■■YOU WILL FIND THE PROGRAMS GIVE PLENTY
1160 PRINT"■OF PROMPTS AT THE APPROPRIATE PLACES.
1170 PRINT"■■■■  HAVE A 'BUMPER' CROP! ■■" POKE59468,30 END
1180 PRINT"■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■".
1190 PRINT"      ■PRESS ANY KEY TO CONTINUE";
1200 GETA$ IFA$=""THEN1200
1210 PRINT"■";:RETURN
```

```
100 POKE59468,12
110 DIM#(20),S(20,10),M$(12)
120 L$="──────────────────────────────────────" :G=32:W=29
130 DEFNA(V)=INT(V*10^2+.5)/10^2
140 FORI=1TO220:READV$:T=T+ASC(V$):NEXT
150 FORJ=1TO12:READM$(J):NEXT
160 DATABROAD BEAN,1.25,16,16,2,5,16,0,304,104,0,0
170 DATABROCCOLI,1.15,20,12,2,5,16,0,304,5,0,0
180 DATARUNNER BEAN,1.25,100,13,2,12,15,0,305,306,0,0
190 DATABEETROOT,.25,27,16,1,4,12,0,304,5,0,0
200 DATAAPPLE BROCCOLI,.25,1,5,40,,5,0,9,24,4,105,5,6
210 DATABRUSSELL SPROUTS,.25,6,33,,5,0,6,30,205,204,305,6
220 DATASPRING CABBAGE,.25,2,35,,5,0,6,16,207,208,209,210
230 DATASUMMER CABBAGE,.25,2,32,,5,0,6,16,4,105,5,106
240 DATAWINTER CABBAGE,.25,2,32,,5,0,6,12,4,5,305,6
250 DATASUMMER AUTUMN CAULIFLOWER,.25,1,5,21,,5,0,6,24,4,5,305,6
260 DATAWINTER CAULIFLOWER,.25,1,5,40,,5,0,6,24,304,5,306,7
270 DATACARROT,.25,25,16,,5,0,6,0,0,6,0,0
280 DATALETTUCE,.15,30,11,,5,0,12,0,4,107,0,0
290 DATASPRING ONION,.25,2,15,,5,0,12,0,3,208,0,0
300 DATAPARSNIP,,25,30,33,1,5,12,0,3,104,0,0
310 DATAPEAS,1.5,30,14,2,6,36,0,203,106,0,0
320 DATAEARLY POTATO,.5,55,13,5,12,24,0,104,204,0,0
330 DATAMAINCROP POTATO,.5,55,22,5,19,30,0,204,304,0,0
340 DATATURNIP,,25,30,10,,5,0,18,0,104,205,0,0
350 DATASWEDE,,25,30,22,,5,0,18,0,5,6,0,0
360 DATAJAN,FEB,MARCH,APRIL,MAY,JUNE,JULY,AUG,SEPT,OCT,NOV,DEC
370 PRINT"■  ■ OPTIONS ■"
380 PRINT"1. LIST SEEDS■":PRINT"2. CALC. SEED■" PRINT"3. CALC. ROWS■"
390 PRINT"4. MONTH■" PRINT"5. END OF RUN■■" INPUT"■OPTION";O
400 IFO<1ORO>5THEN370
410 ONOGOTO420,710,900,1090,1220
420 GOSUB440 IFV=99THEN370
430 GOTO480
440 PRINT"■  ■SEEDS■" FORJ=1TO20 PRINTJ,TAB(4)V$(J):NEXT
450 INPUT"■■■WHICH NUMBER (99 TO RETURN TO OPTIONS)",V
460 IFV<1ORV>20ANDV<>99)THEN440
470 RETURN
480 PRINT"■  ■";V$(V)
490 PRINTL$ PRINT"SEED PER 30 FT ROW (";:X=S(V,0)
500 IFX<1THENPRINT"OZ)"TAB(Q)X GOTO530
510 IFX<2THENX=X-1:PRINT"PINT)"TAB(Q)X GOTO530
520 PRINT"LBS)"TAB(Q)X
530 PRINTL$:X=S(V,1)
540 IFV>4ANDV<12THENPRINT"YIELD PER PLANT (LBS)"TAB(Q)X:GOTO580
550 PRINT"YIELD PER 30 FT ROW (" IFV=13THENPRINT"HEADS)" GOTO570
560 PRINT"LBS)";
```

PROGRAMS

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570 PRINTTAB(Q)X
580 PRINTL$:PRINT"SOWING-HARVESTING (WEEKS)"TAB(Q)S(V,2)
590 PRINTL$:PRINT"SEED DEPTH (INS)"TAB(Q)S(V,3):PRINTL$
600 PRINT"BETWEEN SEEDS ";
610 IFS(V,4)=0THENPRINTTAB(20)" SOW THINLY":GOTO630
620 PRINT"(INS)"TAB(Q)S(V,4)
630 PRINTL$:PRINT"BETWEEN ROWS (INS)"TAB(Q)S(V,5):PRINTL$
640 IFS(V,6)=0THEN660
650 PRINT"BETWEEN TRANSPLANTS (INS)"TAB(Q)S(V,6):PRINTL$
660 P=S(V,7):GOSUB1230:PRINT"SOW FROM "P$" TO ";:P=S(V,8):GOSUB1230:PRINTP$
670 PRINTL$:IFV<5ORV>11THEN700
680 P=S(V,9):GOSUB1230:PRINT"TRANSPLANT FROM "P$" TO ";
690 P=S(V,10):GOSUB1230:PRINTP$:PRINTL$
700 PRINTL$:GOSUB1280:GOTO420
710 GOSUB440:IFV=99THEN370
720 PRINT"■■■ROW LENGTH"
730 INPUT"■(MULTIPLES OF 5 FEET)";F2
740 F1=INT(F2/5):IFF2<>F1*5THEN730
750 F=F2/30:INPUT"■■HOW MANY ROWS";R:IFR<=0THEN750
760 Y=FNA((S(V,1)*F)*R)
770 PRINT"■      ■";V$(V):PRINT"■"L$:PRINT"FOR"R"X"F2"FT ROWS":PRINTL$
780 PRINT"■SEED REQUIRED (";:X2=S(V,0)
790 IFX2<1THENX=FNA((X2*F)*R):PRINT"OZ)"TAB(W)X:GOTO820
800 IFX2<2THENX=FNA(((X2-1)*F)*R):PRINT"PINTS)"TAB(W)X:GOTO820
810 PRINT"LBS)";:X=(FNA((X2*F)*R)):PRINTTAB(W)X
820 PRINT"■■AVERAGE YIELD ";:IFV=13THENPRINT"(HEADS)"TAB(W)Y:GOTO890
830 IFV<5ORV>11THENPRINT"(LBS)"TAB(W)Y:GOTO890
840 X=FNA(S(V,1)):PRINT"PER PLANT (LBS)"TAB(W)X
850 PRINT"■"L$:PRINT"■IF ROWS REFERS TO TRANSPLANTS THEN:-
860 PRINT"■TOTAL PLANTS";
870 X=FNA(INT((F*30*12*R)/S(V,6))):PRINTTAB(W)X
880 PRINT"■AVERAGE YIELD (LBS)";:X=FNA(X*S(V,1)):PRINTTAB(W)X
890 PRINT"■"L$:PRINTL$:GOSUB1280:GOTO710
900 GOSUB440:IFV=99THEN370
910 PRINT"■■■ROW LENGTH"
920 INPUT"■(MULTIPLES OF 5 FEET)";F2
930 F1=INT(F2/5):IFF2<>F1*5THEN920
940 T$="LBS":IFV=13THENT$="HEADS"
950 PRINT"■■■HOW MANY "T$;:INPUTP:P=INT(P):IFP<1THEN950
960 PRINT"■    ■"V$(V):PRINT"■"L$:PRINT"TO PRODUCE"P;T$" USING"F2"FT ROWS"
970 PRINTL$"■■":X=P/S(V,1):GOSUB1310:P=X:IFV<5ORV>11THEN1010
980 X=P*S(V,6)/12:X=FNA(X/F2):IFX<1THENX=1
990 PRINT"TOTAL PLANTS NEEDED"TAB(24)P:PRINT"■■NUMBER OF ROWS"TAB(24);
1000 GOSUB1310:PRINTX:PRINT"■■SPACE BETWEEN PLANTS"TAB(24)S(V,6)"INS":GOTO1060
1010 X=FNA(P*30/F2):IFX<1THENX=1
1020 PRINT"SEED NEEDED"TAB(24);:F=S(V,0)
1030 IFS(V,0)<1THENT$="OZ":GOTO1060
1040 IFS(V,0)<2THENT$="PINTS":F=S(V,0)-1:GOTO1060
1050 T$="LBS"
1060 F=FNA(P*F):GOSUB1310:IFF<.09THENF=.09
1070 PRINTF;T$:PRINT"■■ROWS TO BE SOWN"TAB(24)X
1080 PRINT"■"L$:PRINTL$:GOSUB1280:GOTO900
1090 PRINT"■";:FORJ=1TO12:PRINTJ;TAB(4)M$(J):NEXT
1100 INPUT"■■■MONTH NO. (99 TO RETURN TO OPTIONS)";M
1110 M=INT(M):IFM<1OR(M>12ANDM<>99)THEN1090
1120 IFM=99THEN370
1130 INPUT"■■■SOW OR TRANSPLANT (S/T)";A$
1140 IFA$="S"THENZ=7:Z1=8:A$=" SOWINGS":GOTO1170
1150 IFA$="T"THENZ=9:Z1=10:A$=" TRANSPLANTS":GOTO1170
1160 GOTO1130
1170 PRINT"■    ■";M$(M);A$TAB(26)"UP TO":PRINTL$:FORJ=1TO20
1180 P=S(J,Z):P1=INT(P/100):F=P-(P1*100)
1190 P2=S(J,Z1):P3=INT(P2/100):F1=P2-(P3*100):IFM=>FANDM<=F1THEN1210
1200 NEXT:PRINTL$:GOSUB1280:GOTO1090
1210 P=P2:GOSUB1230:PRINTV$(J)TAB(26)P$:GOTO1200
1220 PRINT"■■■END OF RUN":POKE59458,30:END
1230 P1=INT(P/100):IFP1=0THENP$="ALL ":F1=P:GOTO1270
1240 IFP1=1THENP$="EARLY ":F1=P-100:GOTO1270
1250 IFP1=2THENP$="MID ":F1=P-200:GOTO1270
1260 P$="LATE ":F1=P-300
1270 P$=P$+M$(F1):RETURN
1280 PRINT"■■■PRESS SPACE TO CONTINUE"
1290 GETA$:IFA$=""THEN1290
1300 RETURN
1310 A$=STR$(X):FORK=1TOLEN(A$):IFMID$(A$,K,1)="."THEN1330
1320 NEXT:X=INT(VAL(A$)):RETURN
1330 IFVAL(MID$(A$,K+1,1))>4THENX=VAL(A$)+1:A$=STR$(X)
1340 K=LEN(A$):GOTO1320
```

```
100 REM*COPYRIGHT*BOB CHAPPELL*26/11/80*
110 DIMG(100,1),N(100,1),S(20,3),V$(20),M$(12)
120 POKE59458,62
130 L$="------------------------------------------------------------"
140 FORJ=1TO20:READV$(J):FORK=0TO3:READS(J,K):NEXT:NEXT
150 FORJ=1TO12:READM$(J):NEXT
160 DEFFNA(X)=INT(X*10+.5)/10
170 DEFFNB(Z)=0-LEN(STR$(INT(Z)))-(ABS(Z)<1)
180 DATABROAD BEAN,16,4,4,2
190 DATAFR.BEAN,20,3,6,4
200 DATARUN.BEAN,100,3,6,5
210 DATABEETROOT,27,4,6,4
220 DATAP.BROCCOLI,1.5,10,5,4
230 DATAB.SPROUTS,2,8,4,3
240 DATASP.CABBAGE,2,9,8,7
250 DATASM.CABBAGE,2,8,5,4
260 DATAWT.CABBAGE,2,8,5,4
270 DATAS/A.CAULI.,1.5,9,5,4
280 DATAWIN.CAULI.,1.5,10,5,4
290 DATACARROT,25,4,6,3
300 DATALETTUCE,30,3,7,4
310 DATASPR.ONION,9,4,8,9
320 DATAPARSNIP,30,8,4,3
330 DATAPEA,30,3,6,2
340 DATAE.POTATO,55,3,4,4
350 DATAM.POTATO,55,4,4,4
360 DATATURNIP,30,3,8,4
370 DATASWEDE,30,5,6,5
380 DATAJAN,FEB,MAR,APR,MAY,JUN,JLY,AUG,SEP,OCT,NOV,DEC
390 PRINT"■■    VEGETABLE PLAN OPTIONS":PRINT"■1. READ IN DATA TAPE
400 PRINT"■2. SHOW GARDEN PLAN":PRINT"■3. UPDATE GARDEN PLAN"
410 PRINT"■4. END OF RUN":INPUT"■■■WHICH OPTION";A
420 A=INT(A):IFA<1ORA>4THEN390
430 ONAGOTO440,470,690,1020
440 PRINT"■■■LOAD DATA TAPE FOR READING":GOSUB1110:PRINT"■■":OPEN1,1
450 FORJ=1TO100:INPUT#1,G(J,0):INPUT#1,G(J,1):NEXT
460 FORJ=1TO100:INPUT#1,N(J,1):NEXT:CLOSE1:GOTO390
470 X1=0:X=0:GOSUB660:FORJ=1TO100
480 IFG(J,0)=0THEN590
490 X1=X1+1:X=X+1:IFX=10THENGOSUB1110:X=1:GOSUB660
500 Q=4:PRINTTAB(FNB(J));J"■";:Q=9:PRINTTAB(FNB(G(J,0)+Q+J));G(J,0);
510 PRINTTAB(11)V$(N(J,1));TAB(23)M$(G(J-1,1)+1);
520 H=G(J,1)+S(N(J,1),1):IFH>12THENH=H-12
530 PRINTM$(H);:Q=37
540 Z2=N(J,1):IFZ2>4ANDZ2<12THEN610
550 Y=INT((G(J,0)/30)*S(Z2,0)+.6):IFY<1THENY=1
560 PRINTTAB(FNB(Y));Y;
```


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PROGRAMS

```
570 IFZ2=13THENPRINT"■■H";
580 PRINT:PRINTL#
590 NEXT IFX1=0THENPRINT"■■NO RECORDS"
600 PRINTL#:GOSUB1110:GOTO390
610 IFZ2=6THENZ3=2.5:GOTO640
620 IFZ2>6ANDZ2<10THENZ3=1.5:GOTO640
630 Z3=2
640 Y=INT((G(J,0)/Z3+■9■Z2,0)+.6):IFY<1THENY=1
650 PRINTTAB(FNB(Y)),Y;"■■■";:GOTO580
660 PRINT"■ ■POW■  ■ROW ■ ■ TYPE OF  ■"TAB(22)" ■DATE■ ■DATE■ ■LBS. "
670 PRINT" ■NO.■  ■LGTH■ ■ VEGETABLE ";
680 PRINTTAB(23)"■GROWN"TAB(28)"■PICK"TAB(33)"■YIELD" :PRINTL# RETURN
690 PRINT"■   ■UPDATE" :PRINT"■■■■■■■■■ROW NUMBER (1-■■■)
700 INPUT"■■■■TYPE 999 TO RETURN TO OPTIONS";N
710 N=INT(N):IFN=999THEN390
720 IFN<1ORN>100THEN690
730 IFG(N,0)=0THEN780
740 PRINT"■■CAUTION.ROW"N"■ HAS AN ■ ISTING ENTRY.":PRINT"■■";:INPUT"
750 INPUT"■■■DO YOU WISH TO OVERWRITE IT ";A#
760 IFA#="N"THEN690
770 IFA#<>"Y"THEN750
780 PRINT"■■■■ROW LENGTH "
790 INPUT"■■(MULTIPLES OF 5 FEET FROM 5-9995)";R
800 R1=INT(R/5):IFR1*5<>RTHEN790
810 IFR>9995THEN790
820 PRINT"■";:FORJ=1TO20:PRINT TAB(5*V#J);J;:NEXT
830 INPUT"■■■■WHICH NUMBER";V
840 V=INT(V):IFV<1ORV>20THEN820
850 PRINT"■":FORJ=1TO12:PRINTJ;TAB(5*N$(J));:NEXT
860 INPUT"■■■■WHICH MONTH";M
870 M=INT(M):IFM<1ORM>12THEN850
880 IFM<=S(V,2)THEN900
890 PRINT"■■CAUTION:LATEST DATE FOR SOWING IS "M$(S(V,2))"." :GOTO920
900 IFM>=S(V,3)THEN950
910 PRINT"■■CAUTION:EARLIEST DATE FOR SOWING IS "M$(S(V,3))"." :GOTO920
920 PRINT"■■DO YOU WISH TO CONTINUE WITH ";:INPUT"■■THIS ENTRY (Y/N)";A#
930 IFA#="N"THEN690
940 IFA#<>"Y"THEN920
950 PRINT"■■■■■ROW■"TAB(11)N
960 PRINT"■■■■■ROW■"TAB(11)N
970 PRINT"■■■ROW LENGTH■"TAB(11)R"FEET"
980 PRINT"■■■VEGETABLE■"TAB(12)V$(V)
990 PRINT"■■■SOWN■"TAB(12)M$(M)
1000 G(N,0)=R:G(N,1)=M:N(N,1)=V
1010 GOSUB1110:GOTO690
1020 PRINT"■■■■IS THERE ANY DATA TO BE WRITTEN"
1030 INPUT"■■■TO TAPE (Y,N)";A# IFA#="N"THEN1100
1040 IFA#<>"Y"THEN1020
1050 PRINT"■■■■LOAD DATA TAPE FOR WRITING":GOSUB1110:PRINT"■■"
1060 POKE243,122:POKE244,2:OPEN1,1,2
1070 FORJ=1TO100:PRINT#1,G(J,0):GOSUB1140:PRINT#1,G(J,1):GOSUB1140:NEXT
1080 FORJ=1TO100:PRINT#1,N(J,1):GOSUB1140:NEXT
1090 CLOSE1
1100 PRINT"■■■■■■■■END OF RUN":POKE59459,10:END
1110 PRINT"■■PRESS SPACE TO CONTINUE"
1120 GETA#:IFA#=""THEN1120
1130 RETURN
1140 IFPEEK(625)<180THENRETURN
1150 POKE59411,93:T=TI
1160 IFTI-T<67THEN1160
1170 POKE59411,61:RETURN
```

ZX80 Bumper Bundle

by Rick Litherland

Here are three programs for the Sinclair ZX80. Perhaps the most interesting is a machine-code routine which flashes the contents of the display file onto the screen for a short time (like the PAUSE command on some programmable calculators) so that you can get animated graphics, etc. The other programs are a hex loader, which makes entering machine-code routines like the above a practical proposition, and a duck-shooting game which uses the pause routine to present a moving target.

Hex loader. This program allows entry of machine-code directly in hex, and also prevents the system from over-writing your routine by creating a gap between the program and variable storage areas. Run the program, and each time an input string is requested, enter one byte of the routine in hex (using two digits- a leading zero counts). The starting address is given by the variable AD. Line 10 should be kept as the first line of the calling program. (Note: the starting address depends on the length of the calling program, so it's advisable to use relocatable code. Also, the array dimensioned in line 1 is a dummy which just opens up the space to be occupied by the routine.)

```
1  DIM A(d/2-1)
2  POKE 16392,PEEK(16394)-1
3  POKE 16393,PEEK(16395)+(PEEK(16394)=0)
10 LET AD=-d+PEEK(16392)+256*PEEK(16393)
20 FOR I=AD TO PEEK(16392)+256*Peek(16393)-1
30 INPUT A$
40 PRINT A$;"  ";
50 POKE I,16*(CODE(A$)-28)+CODE(TL$(A$))-28
60 NEXT I

d=decimal number of bytes in the machine-code
program.
```

PROGRAMS

Hex print This BASIC program prints out the hex listing.

```
10  LET AD=-130 +PEEK(16392)+256*PEEK(16393)
20  PRINT CHR$(212);"PAUSE";CHR$(212);" ROUTINE."
30  PRINT
40  FOR I=AD TO AD+129
50  IF I-AD=8*((I-AD)/8) THEN LET B=USR(AD)
60  LET B=PEEK(I)
70  LET M=B/16
80  LET B=B-16*M
90  PRINT CHR$(M+28);CHR$(B+28);"  ";
100 NEXT I
```

Pause routine. This hex routine causes a one second pause, during which time the results of any PRINT statements can be seen. Also, the top row of the keyboard (numerical keys) is scanned; if one of these is pressed, this value is returned; if none, or more than one, the value returned is −1. This is useful for games needing quick reactions. The length of pause can be changed by POKE ing AD+21, where AD is the starting address:- this byte holds the number of frames to be displayed, so the maximum pause is about five seconds (256 frames).

```
0000 E5           PAUSE  PUSH HL
0001 2A 10 40            LD   HL,(4010H)   ;end of display file
0004 ED 4B 24 40         LD   BC,(4024H)   ;pos of next char
0008 04                  INC  B
0009 AF                  XOR  A
000A B9                  CP   C
000B 3E 76               LD   A,76H        ;
000D 28 02               JR   Z,NEWLN      ;
000F 77           NEXT   LD   (HL),A       ;fill out display file
0010 23                  INC  HL           ;with newline chars
0011 10 FC        NEWLN  DJNZ NEXT         ;
0013 11 FF 32            LD   DE,32FFH     ;D is'frame counter
0016 26 BF        FRAME  LD   H,BFH
0018 01 FE F7            LD   BC,F7FEH
001B ED 78        BANK   IN   A,(C)        ;
001D F6 E0               OR   E0H          ;
001F 6F                  LD   L,A          ;
0020 2F                  CPL                ;
0021 FE 01               CP   1            ;
0023 9F                  SBC  A,A          ;
0024 B4                  OR   H            ;scan top row and
0025 A5                  AND  L            ;store in E
0026 A3                  AND  E            ;
0027 5F                  LD   E,A          ;
0028 CB 00               RLC  B            ;
002A CB 04               RLC  H            ;
002C 38 ED               JR   C,BANK       ;
002E 41                  LD   B,C
002F ED 78               IN   A,(C)
0031 17                  RLA
0032 17                  RLA
0033 9F                  SBC  A,A
0034 E6 18               AND  24
0036 C6 20               ADD  A,32
0038 32 23 40            LD   (4023H),A
003B D9                  EXX
003C 06 2A               LD   B,42
003E 10 FE        DELAY1 DJNZ DELAY1
0040 3E 0F               LD   A,0FH
0042 D3 FF               OUT  (FFH),A      ;frame sync pulse
0044 3E EC               LD   A,ECH
0046 06 19               LD   B,25
0048 2A 0C 40            LD   HL,(400CH)
004B CB FC               SET  7,H
```


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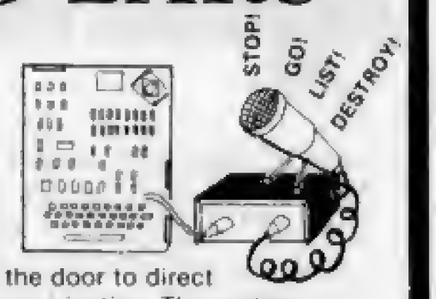
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PROGRAMS

```
004D CD AD 01            CALL 01ADH          ;
0050 3E F3               LD   A,F3H          ;
0052 04                  INC  B              ;
0053 2B                  DEC  HL             ;transmit one frame
0054 FD 35 23            DEC  (IY+23H)       ;
0057 18 00               JR   DELAY2         ;
0059 CD AD 01     DELAY2 CALL 01ADH          ;
005C 06 1D               LD   B,29
005E 00           DELAY3 NOP
005F 00                  NOP
0060 10 FC               DJNZ DELAY3
0062 00                  NOP
0063 D9                  EXX
0064 15                  DEC  D
0065 20 AF               JR   NZ,FRAME
0067 7B                  LD   A,E
0068 1E 78               LD   E,TABLE-PAUSE
006A E1                  POP  HL
006B 19                  ADD  HL,DE          ;TABLE to HL
006C 1E 0A               LD   E,10
006E BE           NOTFND CP   (HL)           ;
006F 28 04               JR   Z,FOUND        ;
0071 23                  INC  HL             ;
0072 1D                  DEC  E              ;convert bit pattern
0073 20 F9               JR   NZ,NOTFND      ;to digit or -1
0075 EB           FOUND  EX   DE,HL          ;
0076 2B                  DEC  HL             ;
0077 C9                  RET
0078 7D           TABLE  DEFB 01111101B      ;bit pattern for 9
0079 7B                  DEFB 01111011B      ;      "        8
007A 77                  DEFB 01110111B      ;      "        7
007B 6F                  DEFB 01101111B      ;      "        6
007C AF                  DEFB 10101111B      ;      "        5
007D B7                  DEFB 10110111B      ;      "        4
007E BB                  DEFB 10111011B      ;      "        3
007F BD                  DEFB 10111101B      ;      "        2
0080 BE                  DEFB 10111110B      ;      "        1
0081 7E                  DEFB 01111110B      ;      "        0
```

Duck shoot. This uses the previous routine. A duck appears in one of six positions, and is shot by pressing the correct numerical key before it disappears again. You get ten shots; the more you hit, the faster the game gets.

Note on keying in: the strings in lines 130 and 140 contain inverse characters, which have to be POKE'd there. If this is too much trouble, these lines can be replaced by:

```
130 IF I=0 THEN PRINT CHR$(6) ;
    CHR$(130) ; CHR$(133)
140 IF I=1 THEN PRINT CHR$(128) ;
    CHR$(128)
```

but you'll have to leave out the rules to avoid running out of RAM.

```
10  LET AD=-130+PEEK(16392)+256*PEEK(16393)
20  RANDOMISE
30  LET B=0
40  LET S=0
50  FOR G=1 TO 10
60  LET N=RND(6)
70  PRINT
80  PRINT
90  FOR I=0 TO 1
100 FOR J=1 TO N
110 PRINT "    ";
120 NEXT J
130 IF I=0 THEN PRINT "▯▮"
140 IF I=1 THEN PRINT "▮"
150 NEXT I
160 PRINT
170 PRINT "    ";
180 FOR J=1 TO 6
190 PRINT "▮ ";
```

```
200 NEXT J
210 FOR I=1 TO 200-5*20
220 NEXT I
230 POKE AD+21,50-5*2
240 IF NOT N=USR(AD) THEN GOTO 410
250 CLS
260 PRINT
270 PRINT
280 PRINT
290 FOR J=1 TO N
300 PRINT "    ";
310 NEXT J
320 PRINT "AWK"
330 PRINT
340 PRINT "    ";
350 FOR J=1 TO 6
360 PRINT "D ";
370 NEXT J
380 POKE AD+21,15
390 LET I=USR(AD)
400 LET S=S+1
410 CLS
420 NEXT G
430 IF S>B THEN LET B=S
440 FOR I=1 TO 100
450 NEXT I
460 PRINT "YOU GOT ";S;" OUT OF 10"
470 PRINT "BEST SCORE: ";B
480 PRINT "DO YOU WANT ANOTHER GO? (Y OR N)"
490 INPUT A$
500 CLS
510 IF A$="Y" THEN GOTO 40
520 IF NOT A$="N" THEN GOTO 480
530 PRINT "BYE"
540 REM RULES
550 REM =====
560 REM
570 REM SHOOT THE DUCK BY
580 REM HITTING A KEY FROM
590 REM 1(LEFT) TO 6(RIGHT)
```

PET Brick stop

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```
5 REM *** BRICK-STOP ***
15 REM *** KJR JONES 7/12/80 ***
20 GOTO 230
30 PRINT "■       ■ PRESS ANY KEY TO START ■"
40 GET A$: IF A$="" THEN 40
50 CLR: PRINT "■": P=33468: TI$="000000": R=PEEK(50003)
60 FOR X=33648 TO 33767: POKE X,102: NEXT
65 REM *** MOVE PLAYER ***
70 K=PEEK(547-381*R)
80 IF (K AND 4)<>4 THEN 120
90 IF K=5 AND P>33448 THEN POKE P+1,32: P=P-1
100 IF K=12 AND P<33486 THEN POKE P,32: P=P+1
110 POKE P,119: POKE P+1,119
115 REM *** MOVE BRICKS ***
120 B=B1: GOSUB 150: B1=B
130 B=B2: GOSUB 150: B2=B
140 GOTO 70
150 IF B=0 THEN B=INT(RND(TI)*40)+32768
160 IF PEEK(B+40)=160 AND B<33488 THEN 200
170 IF PEEK(B+40)=119 THEN POKE B,42: FOR X=1 TO 10:
    NEXT: POKE B,32: B=0: RETURN
180 IF PEEK(B+40)=160 OR B>33607 THEN B=0: RETURN
190 POKE B,32: B=B+40: POKE B,160: RETURN
200 PRINT "■■■■■■■■■■■■";
210 PRINT " YOU SURVIVED FOR ";
    60*VAL(MID$(TI$,3,2))+VAL(RIGHT$(TI$,2));" SECONDS."
220 FOR X=1 TO 100: GET A$: NEXT : GOTO 30
225 REM *** INSTRUCTIONS ***
```

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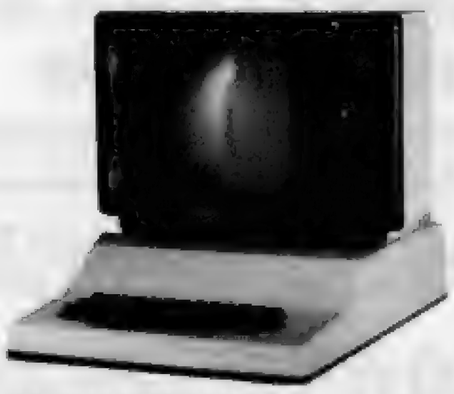
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PROGRAMS

```
230 PRINT "□        ■ B R I C K - S T O P ■"
240 PRINT "■ YOU ARE THE '—' AT THE CENTRE OF THE"
250 PRINT "■SCREEN. YOU CAN MOVE USING THE '<' AND"
260 PRINT "■'>' KEYS TO BLOCK THE PATHS OF BRICKS"
270 PRINT "■WHICH ARE FALLING FROM THE SKY."
280 PRINT "■ BRICKS WHICH YOU DO NOT STOP ACCUMULATE";
290 PRINT "■IN A WALL AT THE BOTTOM OF THE SCREEN."
300 PRINT "■WHEN THIS REACHES YOUR LEVEL, THE GAME"
310 PRINT "■IS OVER."
320 PRINT "■ YOUR OBJECT IS SIMPLY TO STAY ALIVE FOR";
330 PRINT "■AS LONG AS POSSIBLE."
340 GOTO 30
```

ZX80 Printer listing continued from page 115

```
150 LET Q=118
155 LET D=16397
160 STOP
1000 REM PRINT OUT CONTENTS OF ARRAYS
1005 GO SUB 30
1010 LET A=12
1020 GO SUB 20
1030 PRINT "CONTENTS OF ARRAYS A AND B"
1040 GO SUB 30
1045 PRINT "BAUD RATE 1200-PARITY EVEN"
1046 GO SUB 30
1050 FOR I=0 TO 17
1060 PRINT "A(";I;")",A(I),"B(";I;")",B(I)
1070 GO SUB 30
1080 NEXT I
1090 FOR I=18 TO 20
1100 PRINT "A(";I;")",A(I)
1110 GO SUB 30
1120 NEXT I
1130 STOP
9900 REM LISTING ROUTINE
9905 LET P=D+27
9910 IF PEEK(P)>39 THEN STOP
9915 LET LN=256*PEEK(P)+PEEK(P+1)
9920 PRINT LN;
9925 LET P=P+2
9930 LET CH=PEEK(P)
9935 LET P=P+1
9940 IF NOT CH=0 THEN GO TO 9955
9945 GO SUB 30
9950 GO TO 9910
9955 IF CH=1 THEN LET CH=212
9960 PRINT CHR$(CH);
9965 GO TO 9930
```

YCW listing continued from page 106

```
19Ø INPUT A$
2ØØ LET B=(256*PEEK(16414)+PEEK(16414))/1Ø
21Ø CLS
22Ø IF B > 1Ø THEN LET B=B-1Ø
225 IF B > 2Ø THEN LET B=B-2Ø
23Ø IF B > 3Ø THEN LET B=B-3Ø
24Ø IF B > 4Ø THEN LET B=B-4Ø
25Ø IF B > 5Ø THEN LET B=B-5Ø
26Ø FOR Y=1 TO B-1
27Ø PRINT ".";
28Ø NEXT Y
29Ø PRINT "+"
3ØØ LET A(B)=Ø
32Ø LET X=X+1
34Ø LET D=Ø
35Ø FOR Y=1 TO 1Ø
36Ø IF A(Y)=Ø THEN LET D=D+1
37Ø NEXT Y
38Ø IF D=1Ø THEN GOTO 44Ø
34Ø GOTO 7Ø
4ØØ CLS
41Ø PRINT
42Ø PRINT,"INVADERS HAVE LANDED"
43Ø STOP
44Ø CLS
45Ø PRINT
46Ø PRINT,"ALL INVADERS KILLED"
47Ø PRINT,"IN ";X-1;" GOES"
48Ø STOP
```

DRAW POKER

Continued from page 73

and then added to variables called BADBETSTOTAL and ALLBETSTOTAL. The quotient BADBETSTOTAL/ALLBETSTOTAL is an indication of the extent to which that player bluffs, and is called the 'bluff factor' (BF).

When the program next comes to adjust the pointer for that player, it multiplies the calculated adjustment by (1-BF). This means that if the player is known to bluff all the time (ie BF=1), no inference about the strength of his hand will be made from his betting. But if he is known to bluff very rarely, BF will be low and the pointer adjustment will be very little changed from the calculated one.

To make the program more sophisticated it would be relatively easy to weight recent experience more than past experience when calculating the bluff factor. For example, BF could be calculated from the relation:

NEW BF := (0.9 x OLD BF) + (0.1 x latest hand BF)

This technique would have the effect of detecting recent changes in playing style by the opponent. A player who had bluffed little or never, but who suddenly changed his betting style and began to bluff at every opportunity, would get away with it for two or three hands at the most, but then the program would 'suspect' and BF would soar to nearly 1.

Making draw poker a many player game

You will almost certainly be playing against your program using a VDU of sort sort, or even a primitive LED for output. It is not really practical under these circumstances for more than one human being to take part in the game at any one time, but you can make the program into an interesting recreation by having it play all the hands apart from your own. The program must not cheat, otherwise it will always win, and it can make its probability calculations from each player's 'seat' each time there is any action, either betting or drawing cards. Start each of the players off with the same amount of money, say £1 million, and play pot limit poker with £10 ante by the dealer. If you discover that the program is consistently too conservative for your liking, lower the 5 percent multiplicative factor. If the program plays too loosely, raise the 5 percent. If you wish to play in a poker game with players of varying styles, some loose some 'tight', have different factors for different players.

Bibliography

The following articles on Draw Poker should be considered more advanced reading for those interested in a more sophisticated approach. Findler, Nicholas V., Klein, Heinz, Gould W., Kowal A., and Menig J.: *Studies on Decision Making Using the game of Poker.* Proceedings of IFIP Congress 1971, Vol. 2.

Findler Nicholas V.: *Studies in Machine Cognition Using the Game of Poker.* Comm. ACM, Vol. 20, pp. 230-245 (1977).

Findler Nicholas V.: *Computer Poker.* Scientific American, Vol. 239, No. 1, July 1978, pp. 112-119.

It will also be essential for a poker programmer to find a book on the game which gives tables showing the odds against making certain improvements when drawing cards. The Steig book mentioned in the text is one such volume, but there are very many others.

PRINTERFACING

Continued from page 64

print head. This would mean that the print density remains constant as the ceramic substrate warms up. This printer generates a train of dot print pulses when the print head is in the correct start position in a similar fashion to the EUY 2E/2T series and a modified DP 822 control circuit would again suffice to drive this printer. Figure 6 gives the connector pin outs for these printers.

Hycom DC-4004A electro-sensitive printer

The DC 4004A is a compact mechanism that can print 48 or 36 characters per line on 120mm paper depending on whether you use a 5 x 7 or a 7 x 9 character matrix. The unit is manufactured across the pond by Hycom and it is available in this country through Seltek Ltd — the mechanism's cost is approximately £115. This printer is somewhat more versatile than the other units that we have looked at because it has a nine-element print head which allows the user to build up characters that are far more legible than a standard 5 x 7 format.

The greatest benefit of a nine-element head will be found when printing lower case figures since you can now print descenders. This mechanism operates in a serial format, printing from left to right, and a modified version of the DP 822 control circuit explained earlier can be used to control the print head. The main advantage with serial printers is that they are very easy to control, unlike a parallel printer which is enough to make even a dedicated (masochistic?) hardware freak like myself reach for a bottle.

Anyway, this printer generates two timing signals, Signal A and Signal B. Both signals are generated by photo-transistors and shutters so there will be no problems caused by dirty contacts. Signal A becomes active when the print head reaches the left hand margin and is ready to start printing the line; when the photo transistor turns off, the motor should be stopped unless, of course, you wish to print another line, in which case you must wait for the

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signal to become active again. Signal B indicates when to print each dot column and is generated continuously so you must count the pulses to ensure that you do not run off the edge of the paper. With a two-dot space between characters, a full 5 x 7 line will last 336 pulses and a full 7 x 9 line will last 324 pulses. You could, of course, print a longer line by allowing only one dot space between characters but the resultant print might be difficult to read.

In order to form dots you must apply a 170 us pulse of −44 V to the electrodes via a current limiting resistor of approx 39 ohms. As with all printers of this type, the motor control circuit must include a dynamic break which short-circuits the motor windings when the motor is turned off, to ensure that the inertia of the printer mechanism does not carry it over into the next line. The motor supply voltage is 12 V at approx 600 mA and the individual print elements draw approx 12 mA each from 43 volt. Finally, 60 mA each. The photo transistors should have emitter load resistors of approx 6k8 ohms although a little experiment may be required. See Figure 7.

Suppliers of units mentioned in this section:

National EUY series:
Datac Ltd, Tudor Road, Broadheath, Altrincham WA14 5TN, tel 061-941 2361/2.
Hycom DC − 4004A:
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PUNTER'S PET



Continued from page 90

generating a random number in the range 0 to 1 and scanning the list for a match, as in Table 3.

After the race

When the race is over, the result is displayed together with the bookie's cash movements.

There is an option to re-run the race for fun without putting on any extra bets. This will demonstrate the randomnes of the race in that, if the race were run enough times, the probabilities expressed in the odds would be realised. The favourite would win most times but outsiders would win occasionally.

```
3 REM COPYRIGHT ALAN GREEN 1980
15 PRINT"■■■
```

```
549 PRINT"■        ┌──────────────────────┐                    "
550 PRINT"         │ ■RACE...■ODDS...■BET │                    "
551 PRINT"         └──────────────────────┘                    ":IFT=50THEN555
553 PRINT"         ■ TICKETS ISSUED ■";T;"■":GOTO560
555 PRINT"         ■ALL TICKETS ISSUED ■■"
560 GETC$:IFC$=""THEN560
565 IFC$="B"THENGOSUB2000
570 IFC$="O"THENGOSUB4000
575 IFC$="R"THENGOTO10000
580 IFC$="B"THENGOTO500
585 IFC$="O"THENGOTO500
590 GOTO500
2000 IFT=50THENRETURN
2002 T=T+1
2005 INPUT"■■■■■■■■■■■■   HORSE NUMBER    ■ ";H:IFH=<NTHEN2025
2015 PRINTTAB(20);"■■■■■■■■■■■■
```

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```
13000 Q(0)=0:Q(1)=0:PRINT"■■■■■■■■"
13015 FORI=1TON:P(I)=0
13017 PRINT"■■■■■■■■
```

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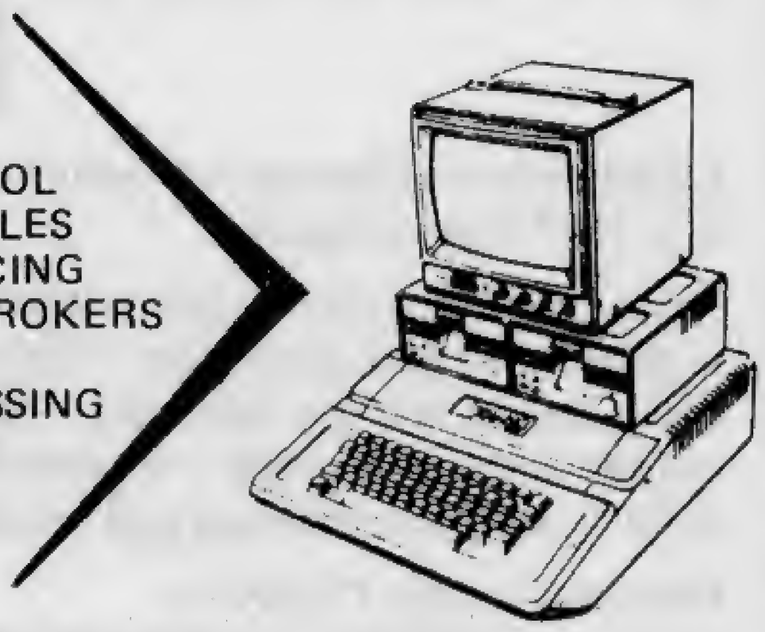
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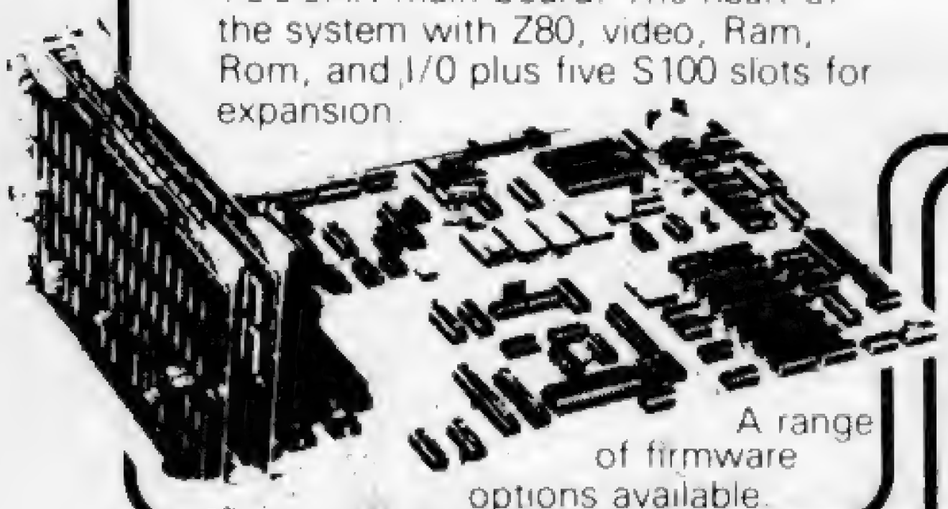
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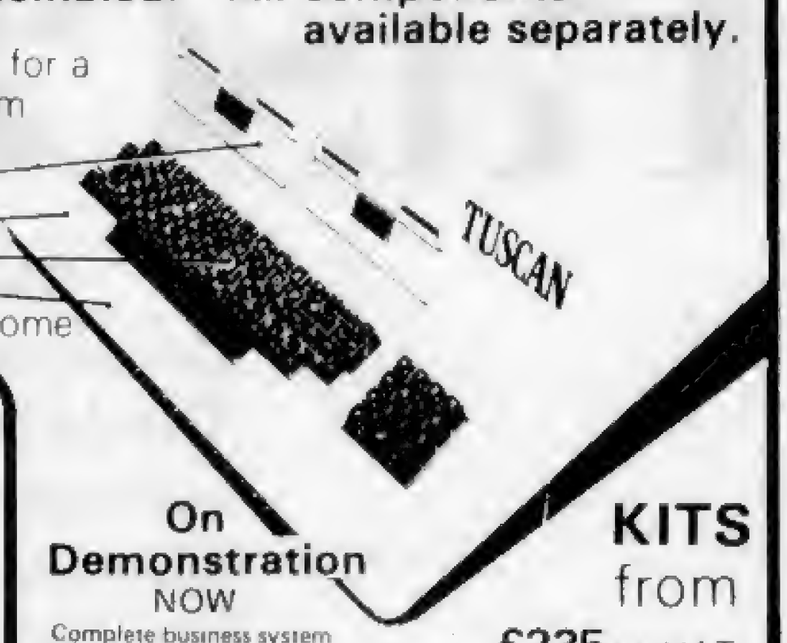
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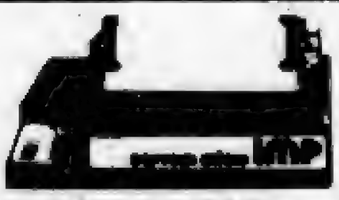
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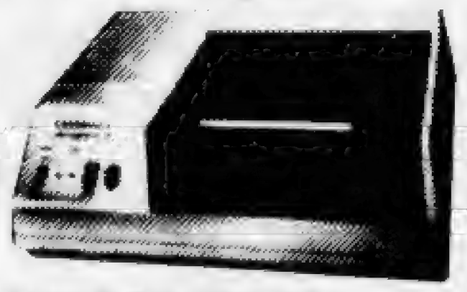
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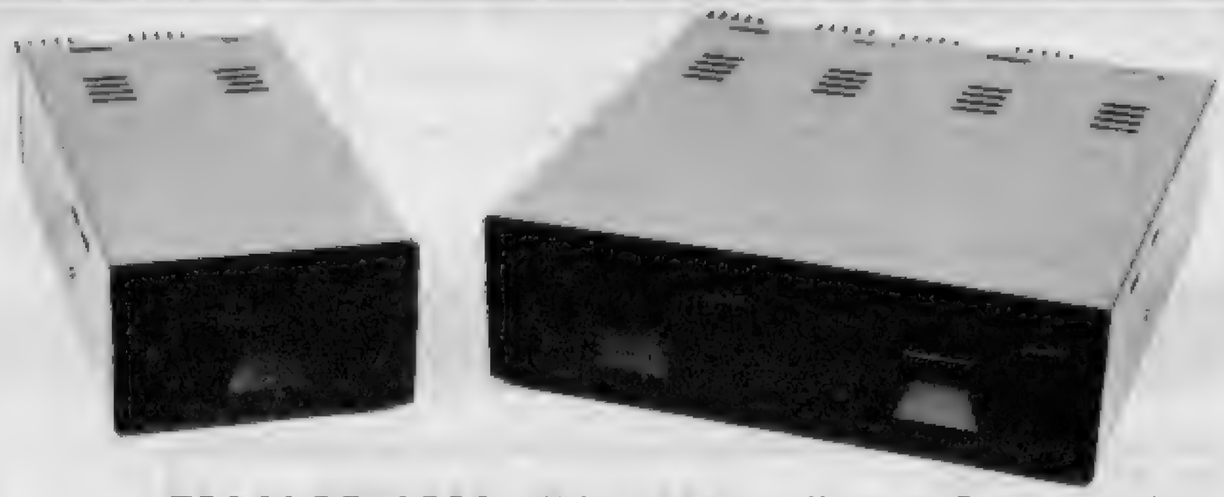
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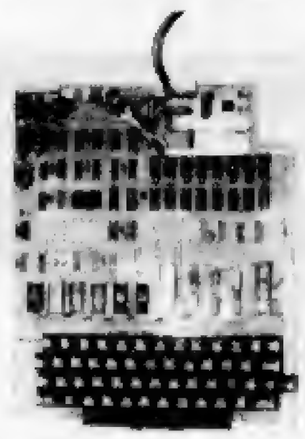
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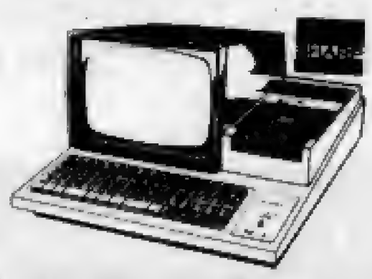
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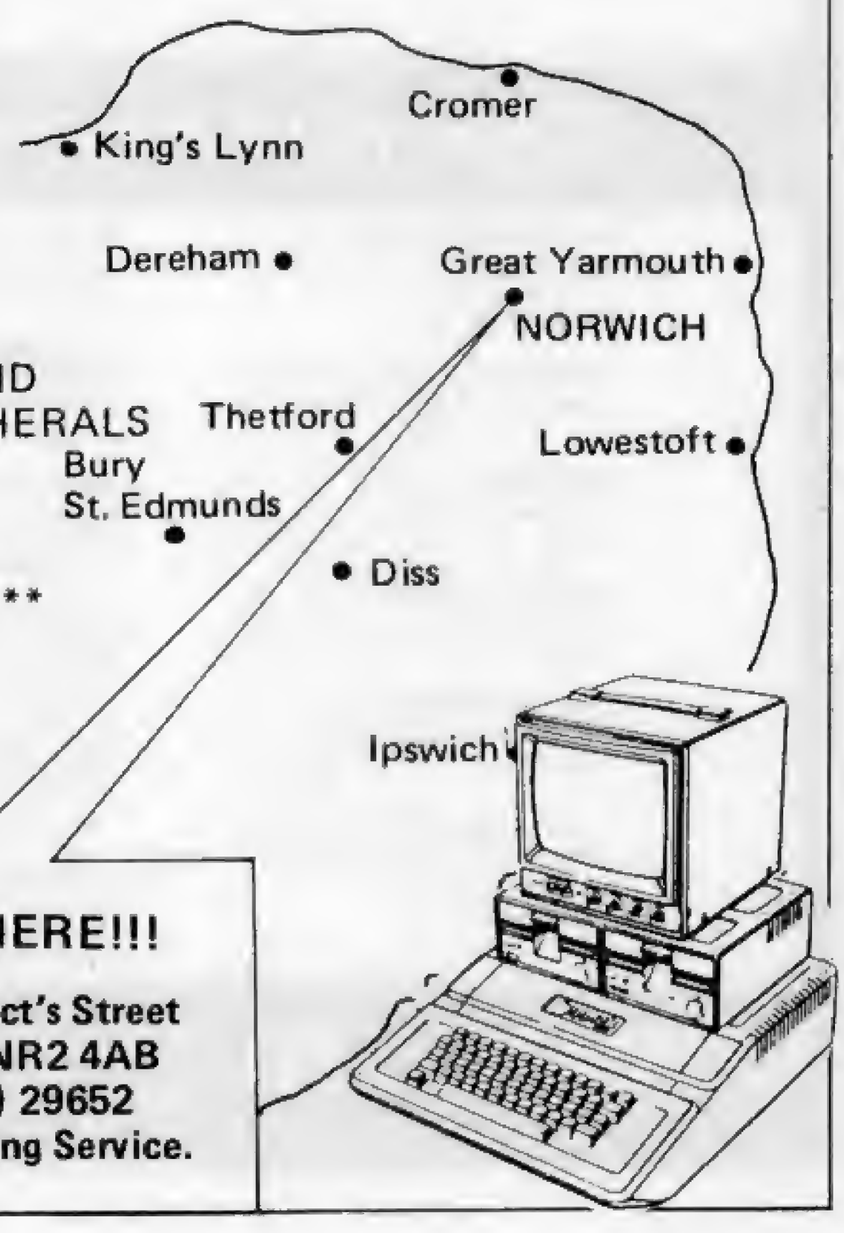
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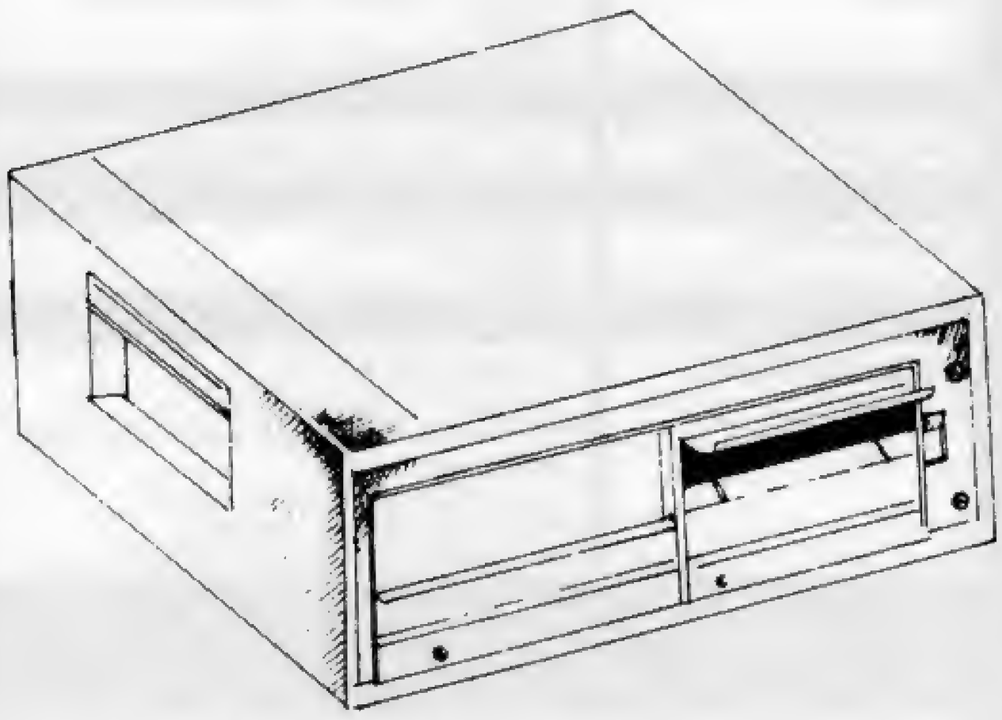
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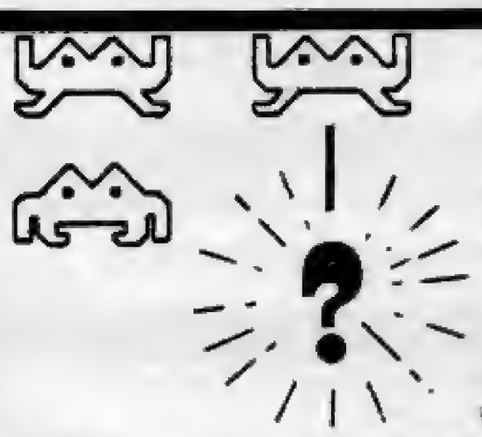
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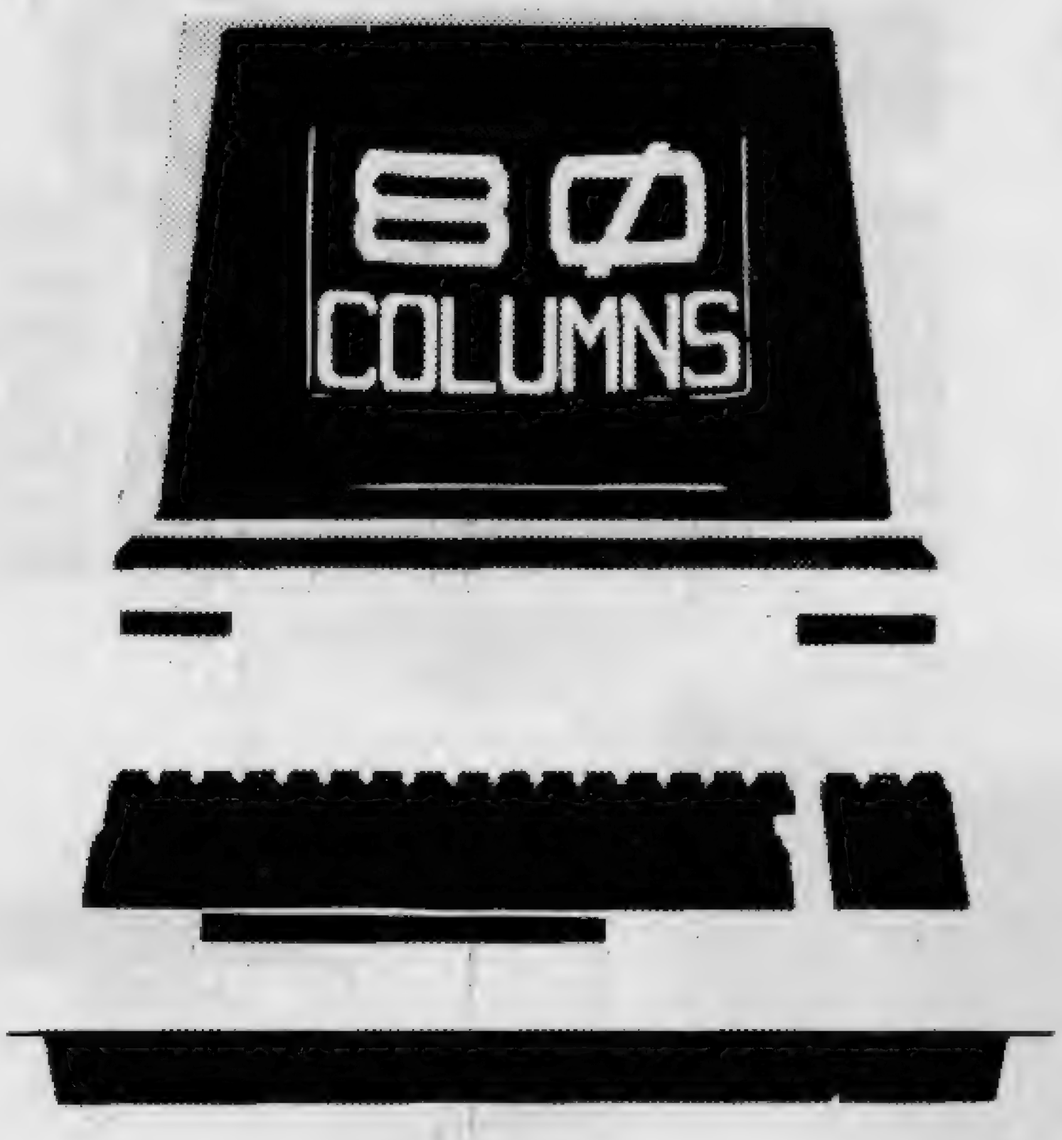
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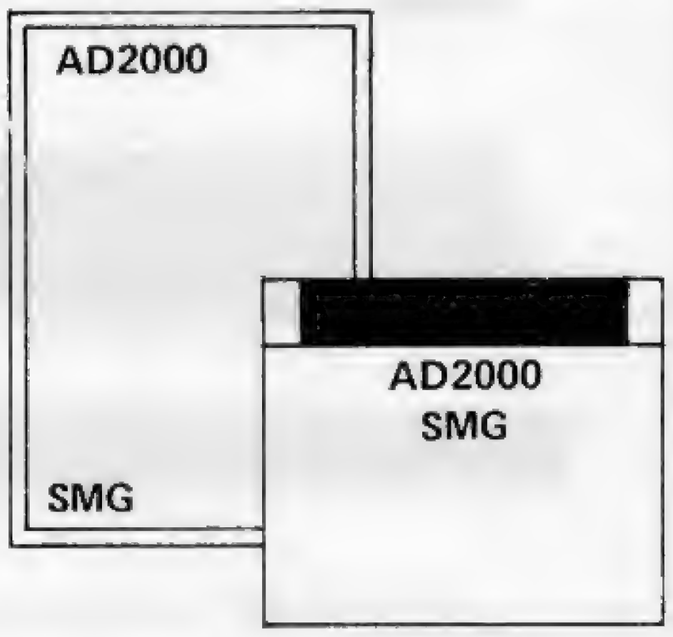
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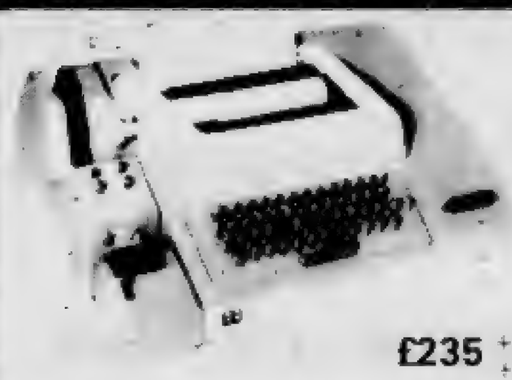
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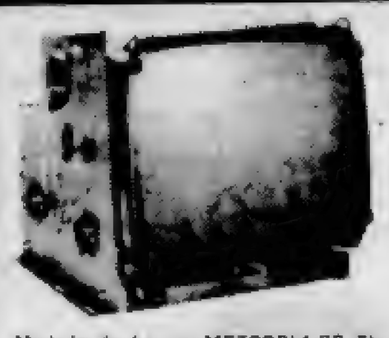
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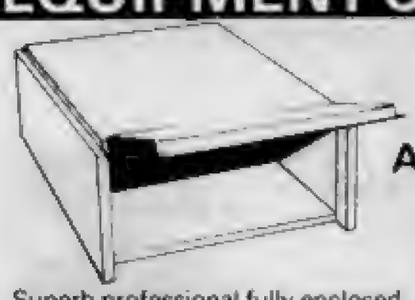
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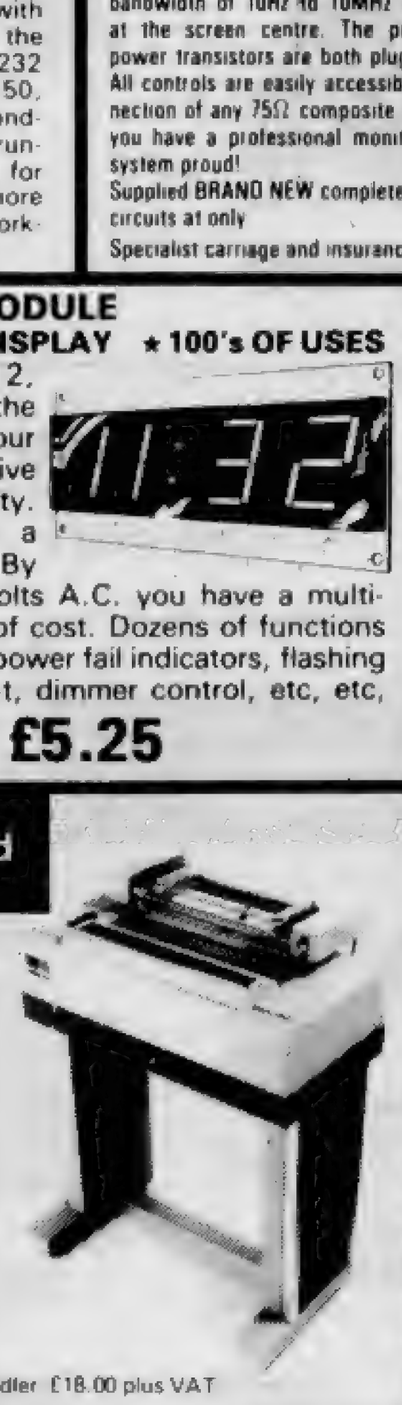
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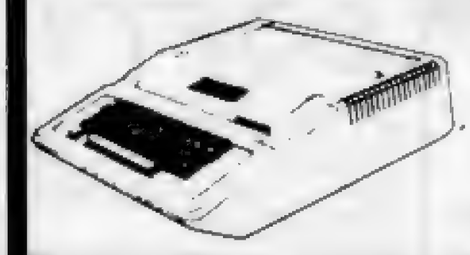
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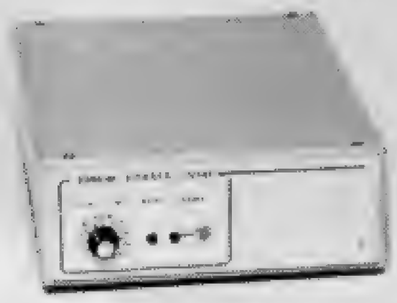
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This is used in conjunction with 'Kemitron' Z80 boards to interface to twin single density S/S 8" floppy disks. It is not available as a bare board, but only built and tested, less circuit diagram £165.00

To run CP/M on the system a serial interface (e.g. SIO board) to some sort of VDU or terminal is required, and 32K of RAM (e.g. two MXD-2 boards). The MZB-3 board has facilities for 'power on jump' and a 'boot prom' to load the CP/M operating system from the disk.

Boot PROM (2708)	£19.95
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T.V. MONITOR P.C.B. for OEM users

This is an assembled P.C.B. size 130 x 190mm, which you add to your own 12"/14" black and white C.R.T. (90 degree, 20mm dia. neck), to obtain a T.V. monitor at modest cost. (Regrettably we cannot supply the C.R.T. at present.)

Preset controls, contrast, brightness, etc., are included, and the only inputs needed are 15 Volts ± 10% AC at 1.5 Amps and 1 Volt pk-pk composite video input.

Supplied with circuit diagram £33.50

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SC/MP II (4MHz)	£10
INS 8154 RAM I/O	£9.40

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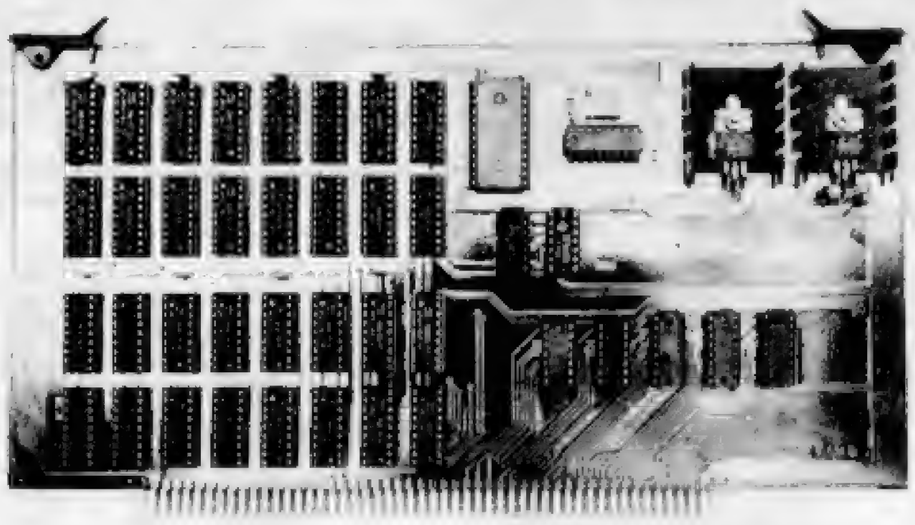
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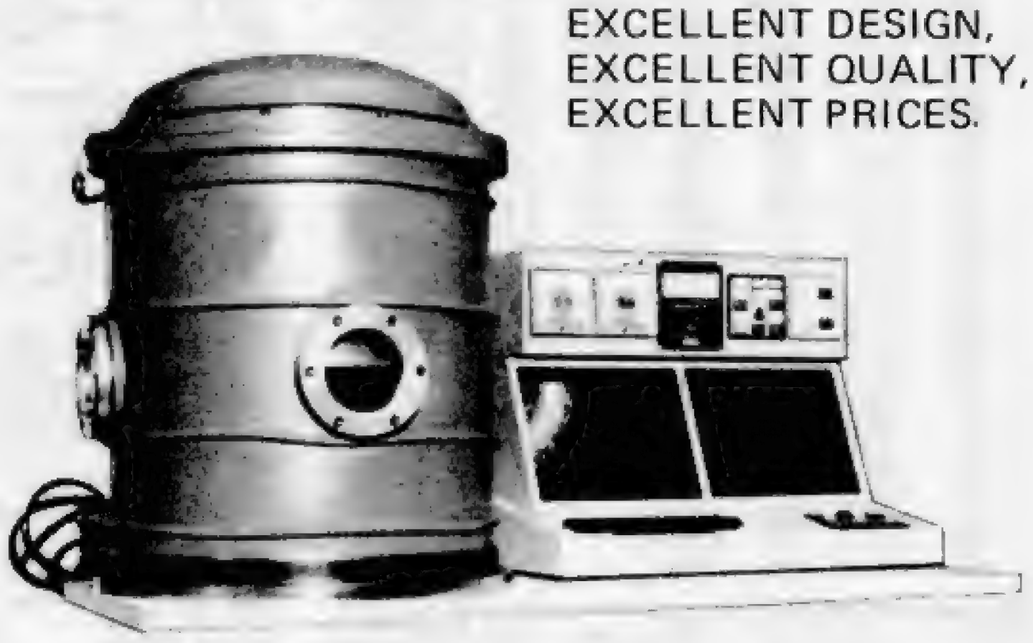
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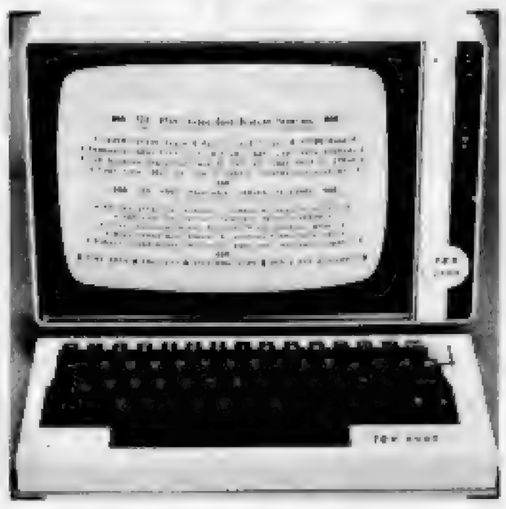
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The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync



SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

Lots of Games and Applications

Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where **SYNC** comes in. **SYNC** evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, **SYNC** to be a respected and successful magazine.

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PRICE LIST

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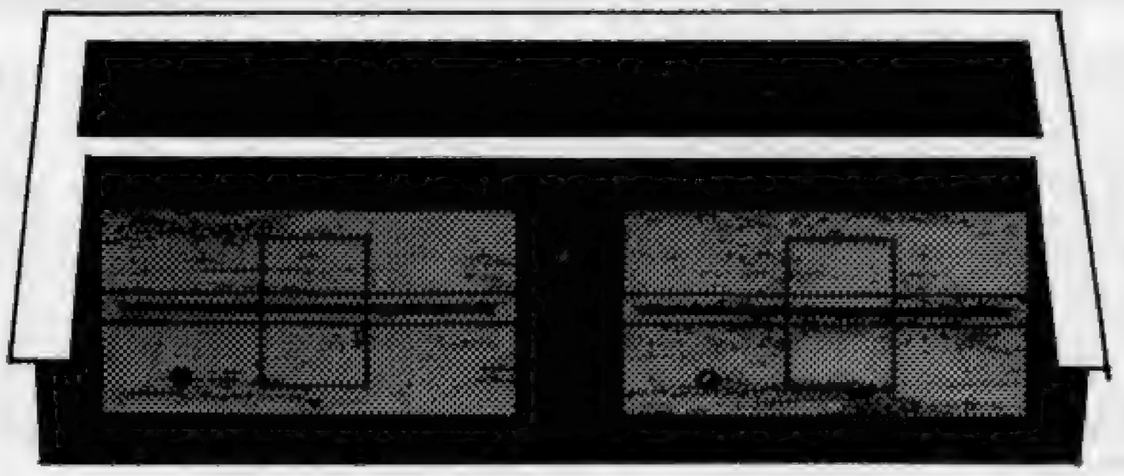
Every VP-9500 comes complete with VPLIB, our library of Micrsoft FORTRAN-callable array processing routines. Typical cals to VPLIB are CALL VSQRT (A, C, N) where the square roots of all of the N floating point numbers in array A are calculated and placed in array C; and CALL VMUL (A, B, C, N) where the N elements of array A are multiplied by the corresponding elements of array B and the results stored in array C. VPLIB contains over 100 such routines.

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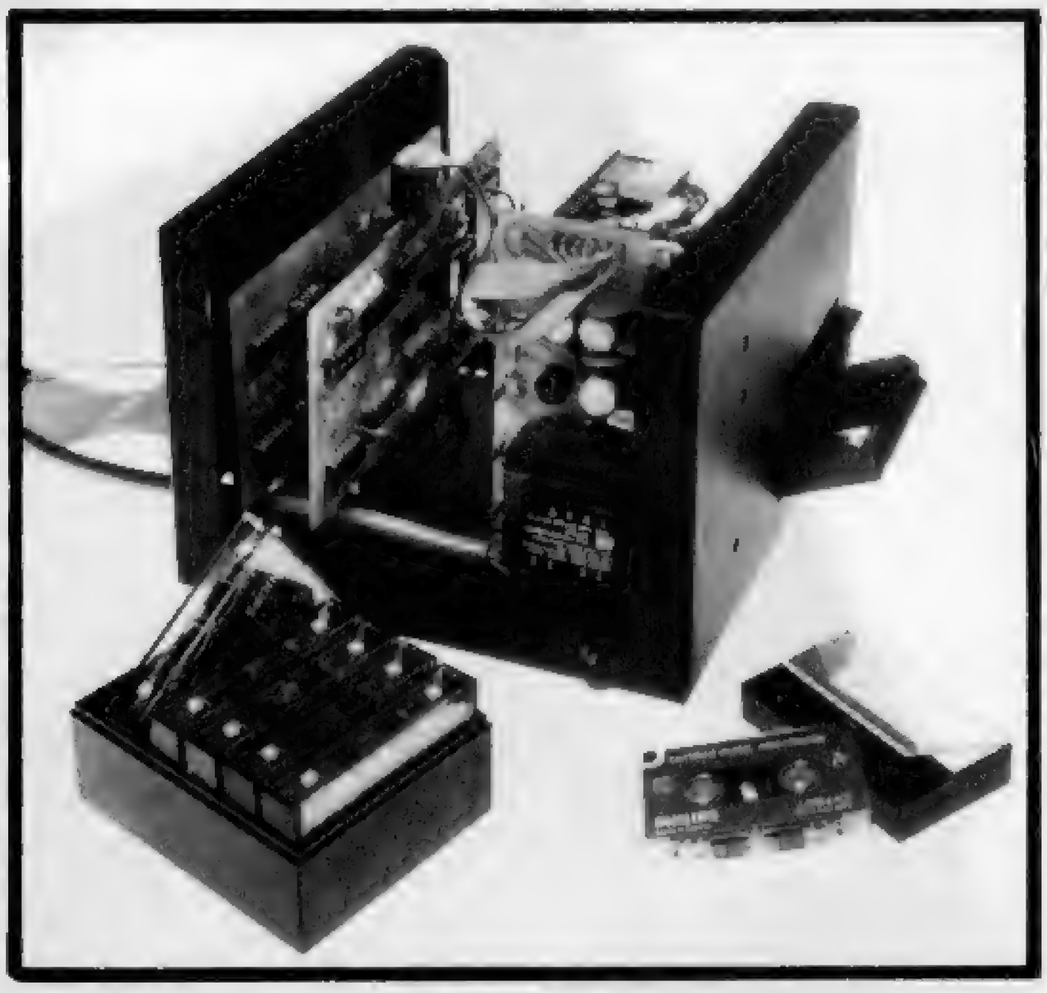
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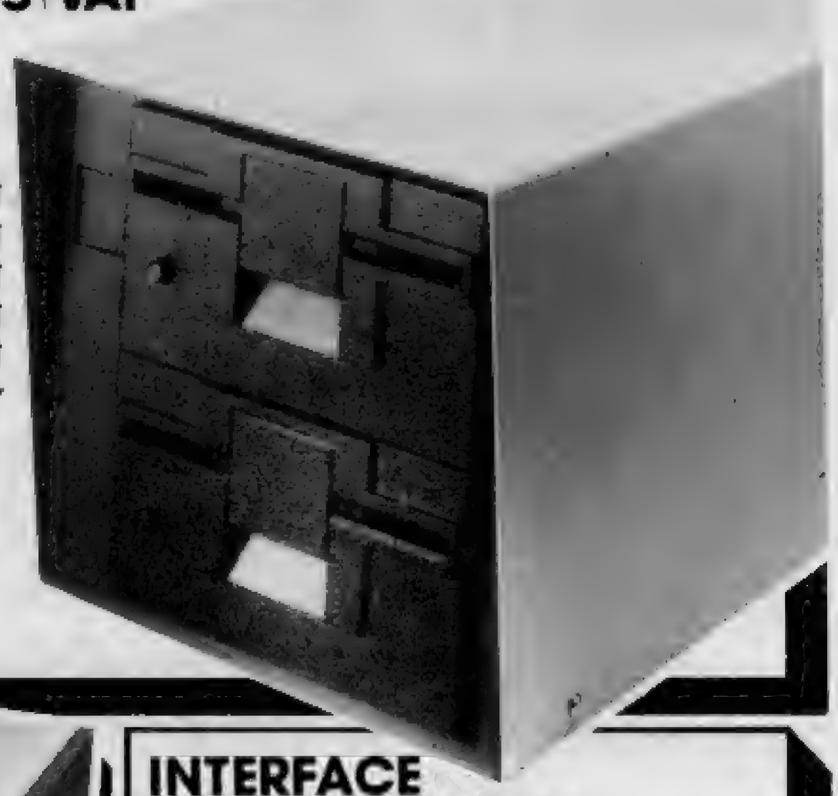
Nascom 2 Single drive system	£450 + Vat
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Single drive system ..... £395 + VAT
(please state which Nascom the unit is for)

Certain parts of the CP/M and D-DOS disc systems are available in kit form. Details available on request.



ENCLOSURE FOR N2+5



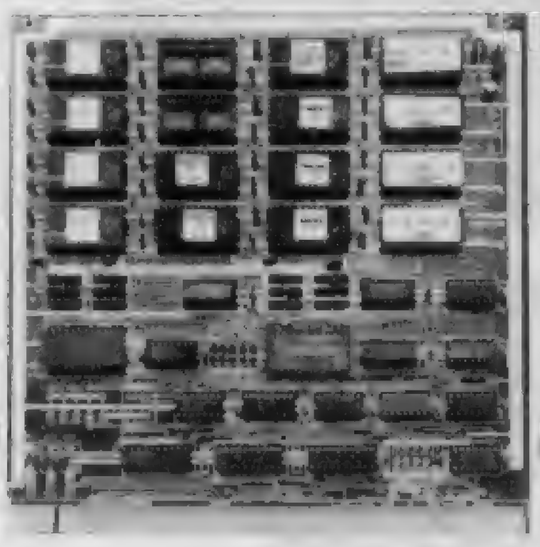
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All the products are available while stocks last from the Nascom dealers below.
(Mail order enquirers should telephone for delivery dates and post and packing costs.) Access & Barclaycard welcome.

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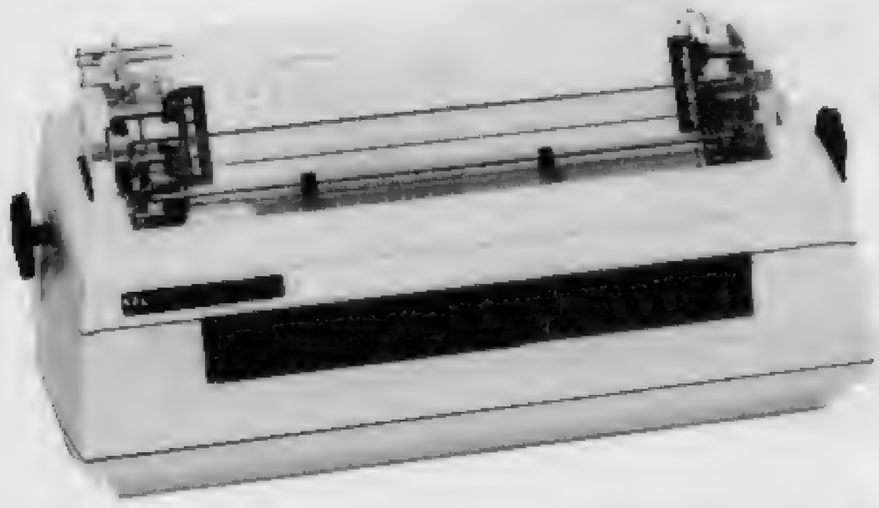
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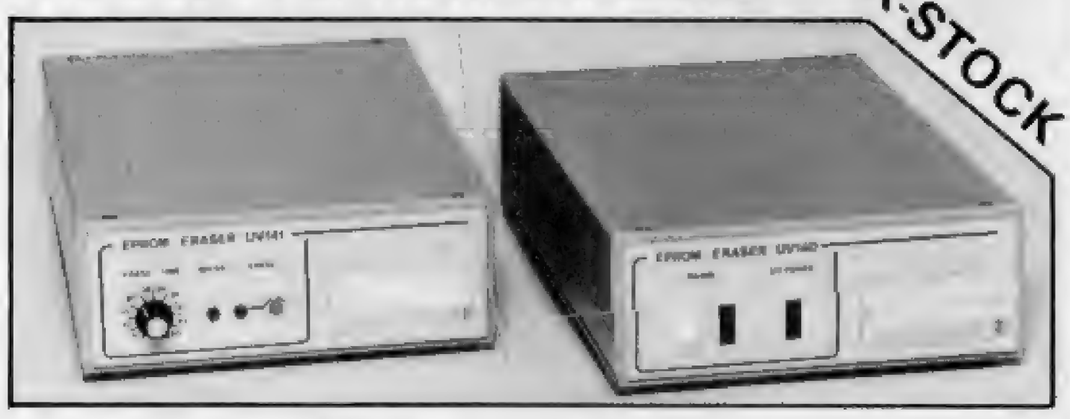
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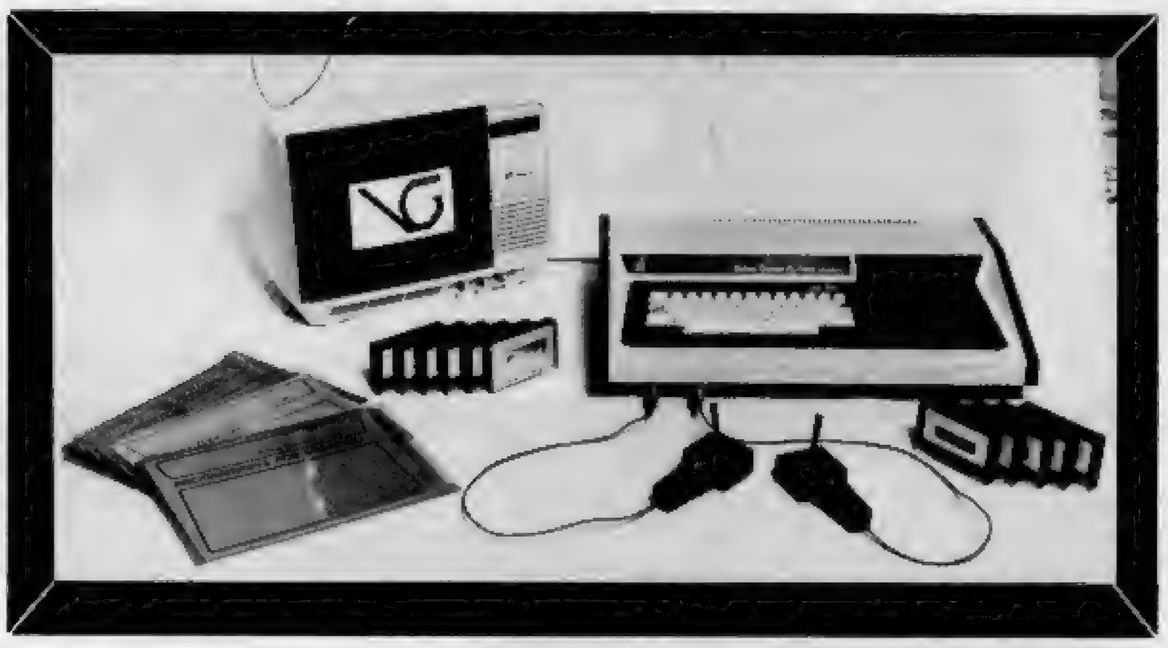
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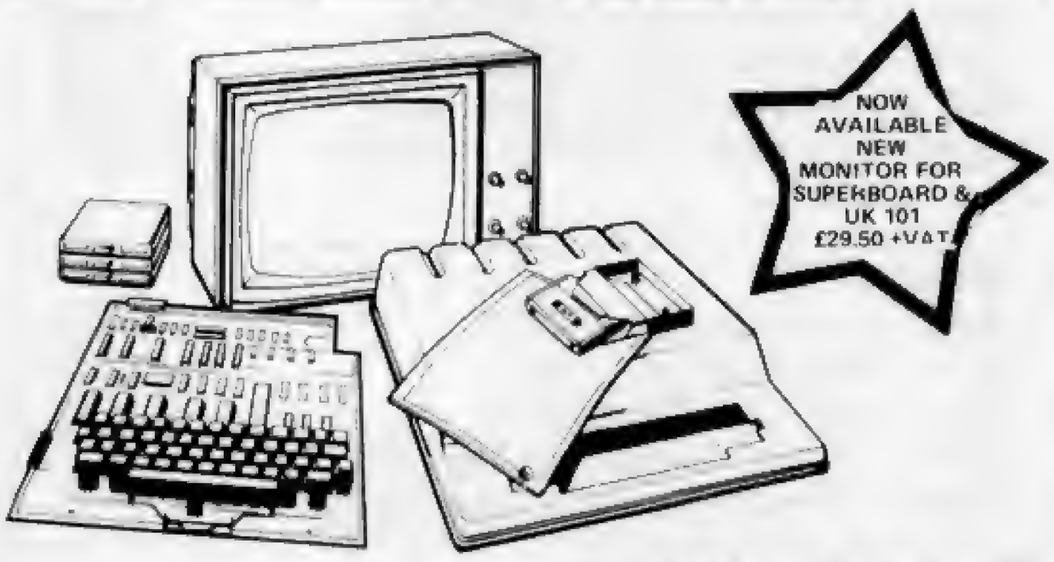
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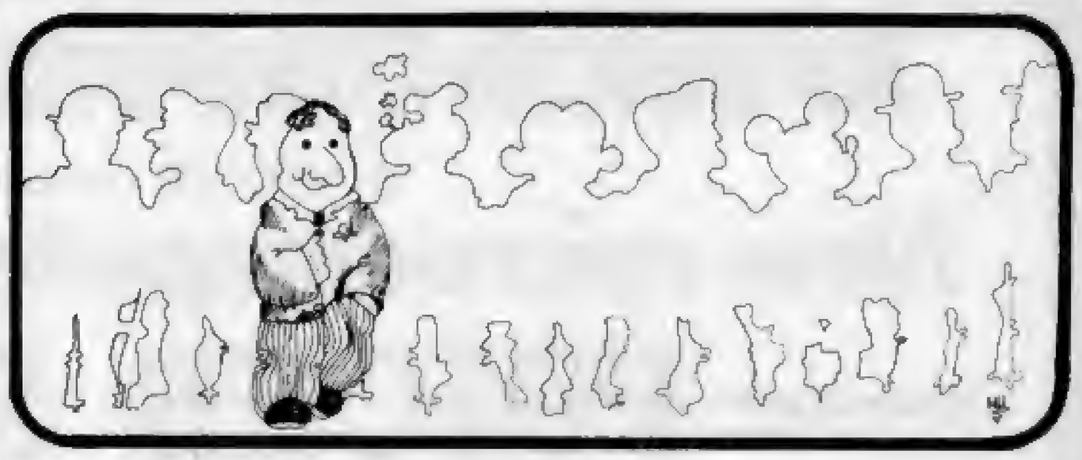
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PCW 181

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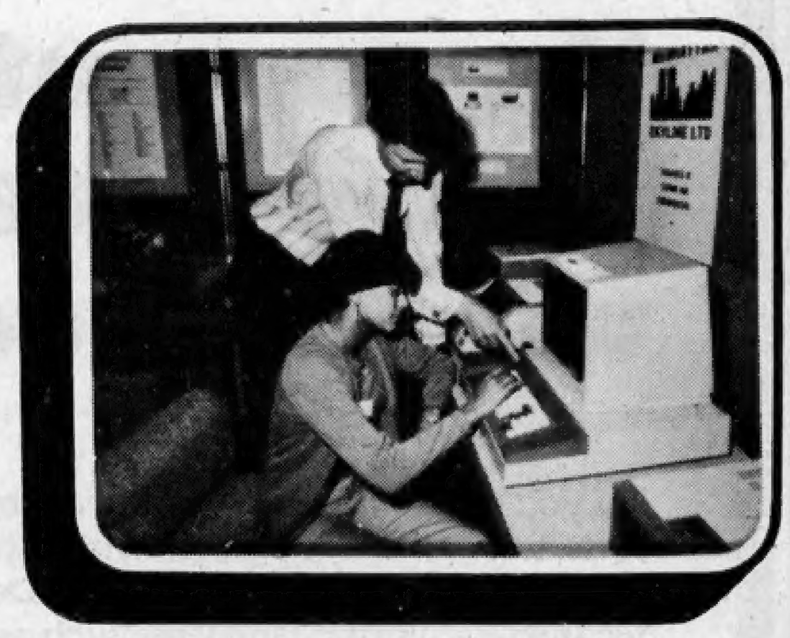












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D R G Business							

CHIP CHAT

Snippet picked up on a recent visit to Commodore — they own an LCD plant. Wonder how long it'll be before we see some interesting (book size?) LCD screens?. . . Apparently Berkshire taxi drivers read *PCW*. Every time Julian Allason gets into a taxi he is greeted with the words 'Hello squire!'. . . A certain finance manager from London E8, when asked in the reader survey, 'What else would you like to see in *PCW*', replied 'Sue Eisenbach in a wet T-shirt!' We tracked Sue down to a Christmas party where she confessed to being too drunk to think of a reply!. . We wonder sometimes about the people who go in for our 'Leisure Lines' puzzles. In just one day we received four entries without the senders' names and addresses. . . A certain advertiser (sometimes) in Street, Somerset has taken to giving lectures on computing to a bunch of Druids. It helps them in their preparation of homoeopathic medicines, apparently. It's a long way from witches' cauldrons. . Our dear friend from *Toady* — Henry 'Shoestring' Budgett — has confessed that he is an actor, of sorts. From January he becomes Acting Editor. . . Read February's *Printout* for 1981's hottest panto review. In fact it's probably 1981's *only* panto review to date. . Alistair Kelman of legal fame is apparently using conjuring tricks to explain program copyright problems to the judge. Rumour has it that Alistair trotted into court carrying two lovely red velvet bags — one small, the other large. Holding a postage stamp in one hand and brandishing an empty smaller bag in the other, Kelman dropped the stamp into the bag. Two seconds later he withdrew *two* stamps. He then repeated the trick with the larger bag and a floppy disk — two by the time he'd finished. 'And what,' so the story goes, 'would you think of the person who produced the bag, your honour?' said Kelman. We eagerly await developments. . .Commodore has withdrawn its tractor printer, apparently to get the ROM fixed. Other manufacturers can look forward to an upsurge in sales for a couple of months, then expect Commodore back with a vengeance. . A heavy letter landed on the editorial desk this month. It was from Markham and Markham of Chelsea, claiming to represent Brigadier 'Bumper' Harris. 'It is clear that your reports tend to ridicule our client'. . etc, etc, drone, drone, The real 'Bumper' replies: 'Come off it, Inside Trader, you know darned well I was never a Brigadier'. . . Image digitisers and colour printers, Computer Art of Stockport sent us this lovely reply to our December cover, shown below.



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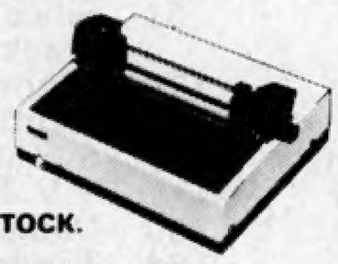
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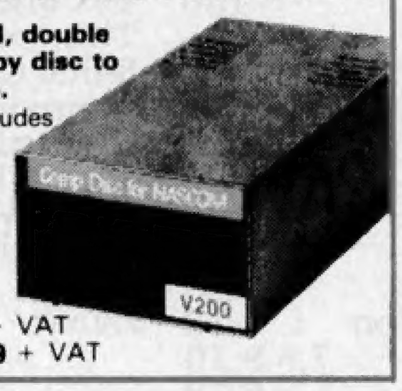
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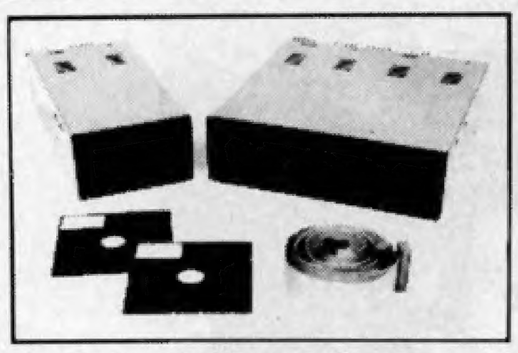
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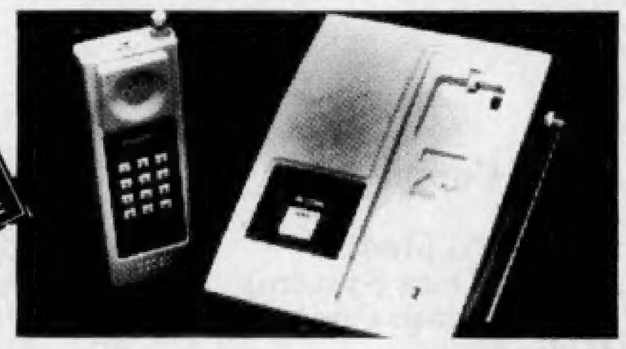


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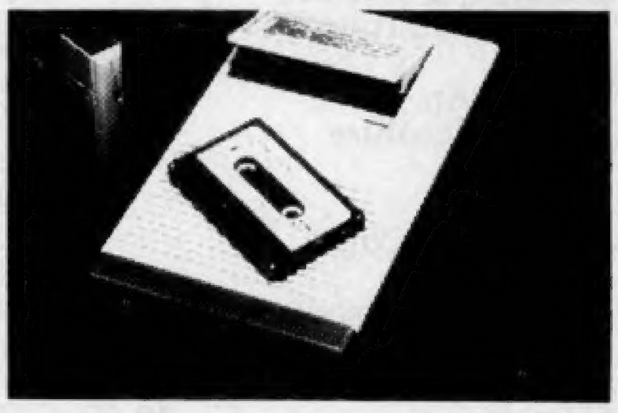
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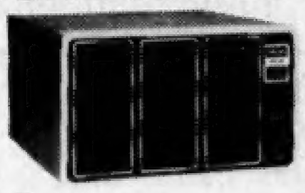
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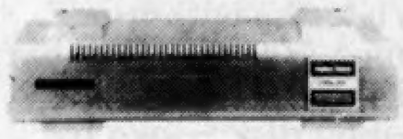
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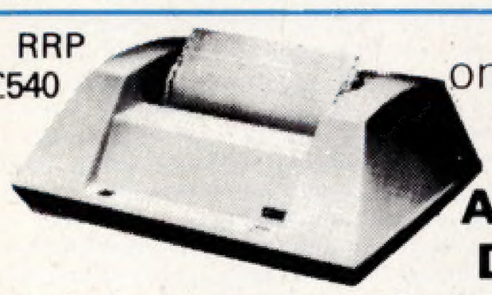
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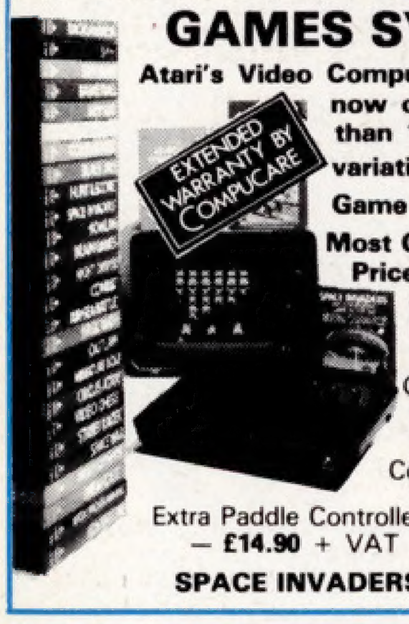


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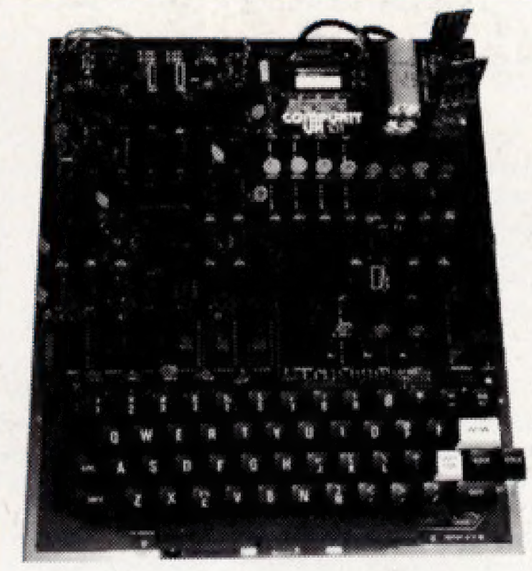
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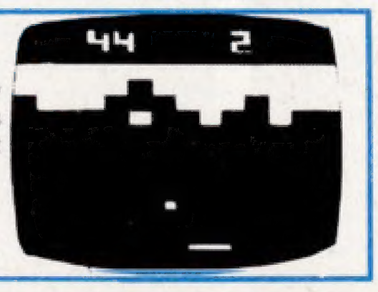
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